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WATER QUALITY STANDARDS CONFERENCE, STATE OF IOWA. IOWA INTERSTATE WATERS OF THE MISSISSIPPI RIVER BASIN CONVENING APRIL 8, 1969, DAVENPORT, IOWA

Federal Water Pollution Control Administration
Chicago, Illinois

1974

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WATER QUALITY STANDARDS CONFERENCE

STATE OF IOWA

Iowa Interstate Waters
of the
Mississippi River Basin
Convening April 8, 1969
Davenport, Iowa

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U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION - CHICAGO, ILLINOIS

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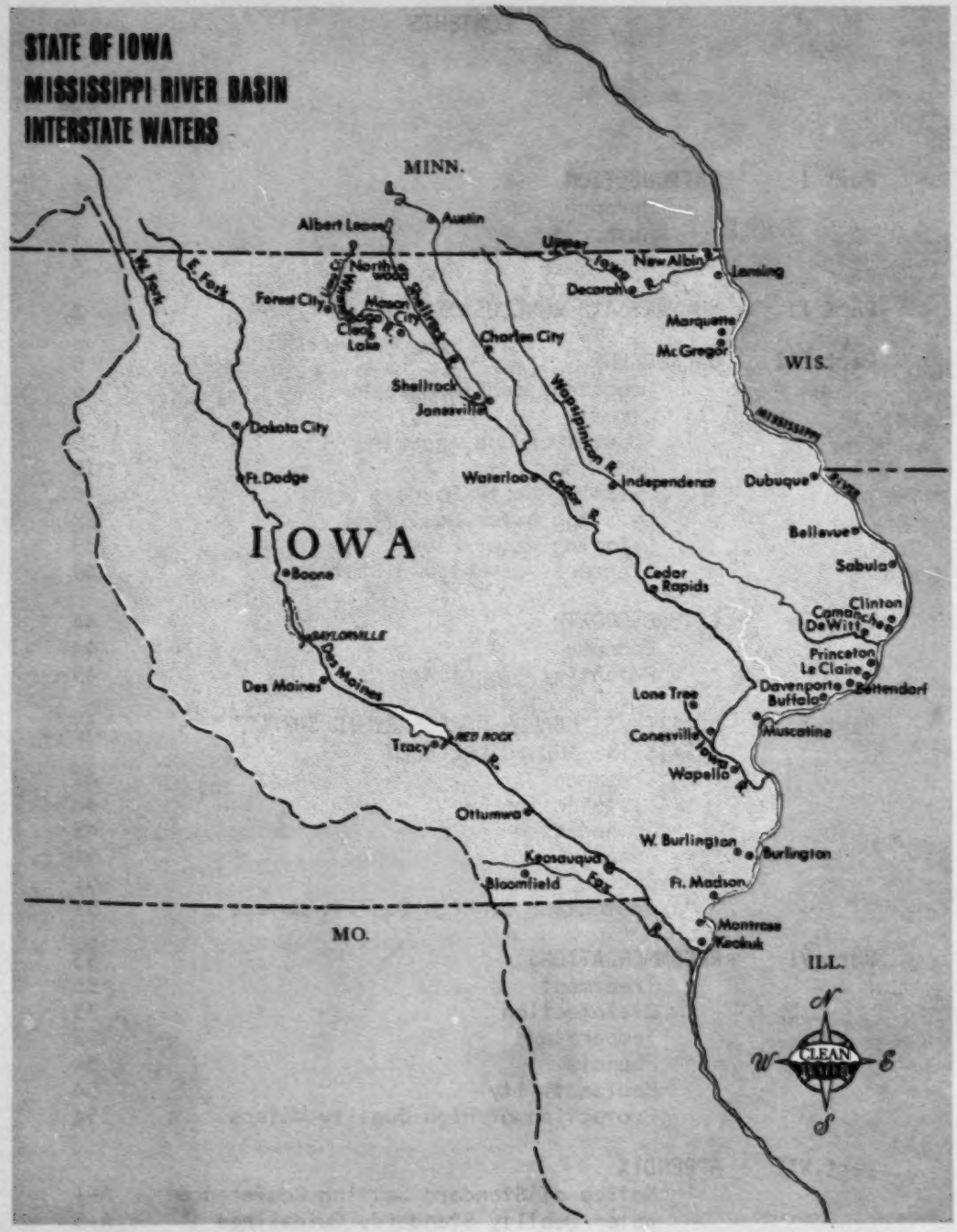
STATE OF IOWA
MISSISSIPPI RIVER BASIN
INTERSTATE WATERS
MINN.
Albert Lea
Austin
Upper Iowa R.
New Albin
Lansing
Decorah
Marquette
McGregor
WIS.
Mississippi R.
Dubuque
Bellevue
Sabula
Clinton
Comanche
DeWitt
Princeton
LeClaire
Davenport
Buffalo
Bettendorf
Muscatine
Lone Tree
Conesville
Iowa R.
Wapello
Ottumwa
W. Burlington
Burlington
Ft. Madison
Keosauqua
Bloomfield
Fox R.
Montrose
Keokuk
ILL.
MO.
Red Rock R.
Tracy
Des Moines
Des Moines R.
Baylorville
Boone
Cedar Rapids
Cedar R.
Waterloo
Independence
Wapsipinicon R.
Ft. Dodge
Dakota City
Charles City
Shellrock
Shellrock R.
Jonesville
Forest City
Winnebago R.
Mason City
Clear Lake
Northwood
Winnebago R.
W. Fork
E. Fork
IOWA
N
W
E
S
CLEAN WATER

Part I

INTRODUCTION

Purpose

On March 5, 1969, the Secretary of the Interior called a conference to consider the establishment of water quality standards applicable to the interstate waters subject to the jurisdiction of the State of Iowa. (See Appendix for Notice of Standards Setting Conference.)

This report deals with the interstate waters of Iowa draining to the Mississippi River, including the Mississippi River. Another report deals with the interstate waters of Iowa draining to the Missouri River, including the Missouri River.

The conference is being held in two sessions. The first session convenes on April 8, 1969 in Davenport, Iowa, and will deal with topics covered in this report. The second session of the conference convenes on April 15, in Council Bluffs, Iowa, and will cover material treated in the Missouri River Basin report.

Authority

The water quality standards established by the State of Iowa in accordance with Section 10(c)(1), of the Federal Water Pollution Control Act [33 US Code 466g (c)(1)], were determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water and the purpose of the Act as provided by Section 10 (c)(3) of that Act.

Section 10(c)(2) of the Federal Water Pollution Control Act, as amended, 33 US Code 466 et seq. provides that should the Secretary of the Interior find the water quality standards adopted by the State do not "protect the public health or welfare, enhance the quality of the water and serve the purposes of this Act (The Federal Water Pollution Control Act)," taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial and other legitimate uses, he may, after reasonable notice, call a conference of representatives of appropriate Federal departments and agencies, interstate agencies, States, municipalities and industries involved prior to preparing regulations setting forth standards of water quality to be applicable to the interstate waters or portions thereof. In accordance with the provisions of the Act, the Secretary of the Interior has called this conference.

Scope

The following interstate waters in Iowa which drain to the Mississippi River are discussed in this report:

> The waters of the Mississippi River, Fox River, Des Moines River, East Fork of the Des Moines River, West Fork of the Des Moines River, Iowa River, Cedar River, Shellrock River, Winnebago River, Wapsipinicon River, and Upper Iowa River.

The following items were considered and standards recommended:

1. The treatment requirements and implementation plan for waste dischargers to the Mississippi and Missouri Rivers.
2. The requirements for disinfection of controllable waste discharges which may be sources of bacteriological pollution.
3. The temperature requirement for the interstate waters of the State of Iowa other than the Missouri and Mississippi Rivers.
4. A standard governing the maximum permissible levels of phenol.
5. A standard governing the maximum permissible levels of radioactivity.
6. A statement of policy with regard to the protection or existing high quality waters.

Part II

SUMMARY AND CONCLUSIONS

The material below summarizes the more extensive text of the report:

1. The eastern part of Iowa, comprising the area of that State draining to the Mississippi River, is 24,900 sq. miles or 44 percent of the land area of the State.

2. The same area mentioned above has 1,900,000 people. This area supports twice as many cattle (3,900,000) as people and four times as many hogs (7,500,000) as people. These animals generate animal wastes which cause significant bacterial and nutrient water pollution problems.

3. The food products industry, which includes meat packing, is one of the major industrial activities. This industry is a substantial source of industrial wastes.

4. Except for the Fox River, all interstate waters of Iowa have sufficient waters at all times to support a year round fish population.

5. Municipal and industrial wastes amounting to more than 2,900,000 population equivalents (P.E.) are generated on the interstate waters of Iowa draining to the Mississippi River, excluding the Mississippi River. By 1972, when Iowa's present water pollution control plan for these waters is completed, the discharges to these streams will be equivalent to the oxygen demand of the raw wastes of 439,000 population.

6. Of 18 municipalities which presently discharge wastes to the Mississippi River, two have no treatment at all, 13 have only primary treatment, and three have secondary treatment. The wastes from these municipalities and their industries are equivalent to the wastes from a population of 1,542,870. Secondary waste treatment or its industrial equivalent could reduce the present waste loading to the Mississippi River from 1,542,870 P.E. to approximately 250,000 P.E. Thus, secondary treatment could keep the raw waste equivalent of 1,290,000 persons from the Mississippi River each day.

7. Dissolved oxygen in the Mississippi River measured at Dubuque has fallen below the 8-hour minimum approved Iowa standard of 4 mg/l every year for significant periods since 1964.

8. Mississippi River water increases 21 percent in hardness from the time it passes Dubuque until it reaches Burlington.

9. High bacterial counts and low dissolved oxygen levels presently occur along the Des Moines River. Adequate treatment and disinfection of wastes reduces these problems.

10. High concentrations of bacteria, nitrogen, and phosphates have been measured in the Cedar, Iowa, Shellrock, and Winnebago (Lime Creek) Rivers basin. Much of this is attributable to intense agricultural land use and the consequent use of fertilizers and the deposition on land of animal wastes. High nutrient levels promote excessive algal growth, and as a consequence taste and odor problems may be expected to increase.

11. Water based outdoor recreation has become a rapidly increasing aspect of modern living. This includes swimming, boating, water skiing, canoeing, and other related activities such as sight-seeing, hiking, camping and picnicking. Twenty-four of the 36 stream recreational sites designated by the State are on interstate streams which are the subject of this report.

12. The unsatisfied demand for water related activities was 29,600,000 recreation days in eastern Iowa in 1964.

13. Every State which borders on the Mississippi River, except for Iowa, has adopted as part of its standards a requirement for secondary treatment or its equivalent for wastes discharged into the Mississippi River. This provision, for secondary or equivalent treatment, has been enacted by the States of Minnesota, Wisconsin, Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi and Louisiana. Iowa has adopted secondary treatment for its interior streams.

14. All of the States adjoining Iowa in the Mississippi River basin have established acceptable bacterial criteria for interstate waters, except for Iowa itself. The various provisions for bacterial criteria have been enacted by the States of Minnesota, Illinois, Wisconsin and Missouri. These States require disinfection.

15. All the States bordering upon Iowa in the Mississippi River basin have enacted temperature limits restricting increases to 5° F. or less. These States are Minnesota, Wisconsin, Illinois and Missouri.

16. A population increase of almost 600,000 persons is expected by 1980 in the portion of Iowa which is studied in this report. This increase will be in the urban population, thus intensifying waste discharges from municipal waste treatment plants.

17. The food and chemical industries in eastern Iowa are expected to more than double by 1980 compared to 1960. Total manufacturing will double in the same period. Industrial waste discharges can be expected to increase significantly because of this growth.

18. The number of hogs and pigs, now four times the human population of the study area, is expected to increase significantly in the next decade. This will increase bacterial levels and nutrients in streams unless animal wastes are controlled.

19. By 1980, it is estimated that unsatisfied water related recreation will amount to 49,100,000 recreation days in eastern Iowa. This amount is in excess of the present usage.

20. Secondary treatment is a widely recognized and practical method for the treatment of municipal wastes. Secondary treatment ("activated sludge") was developed in 1914, and current operating procedures enable high plant efficiencies.

21. Pathogenic agents are discharged to water courses from treatment plants. Disinfection markedly reduces these discharges.

22. Temperatures of 90°F. or less and a rise of not more than 5°F. above background levels are temperature levels at which most fish species can thrive.

The recommendations of this report are to be found in Part VI.

Part III

BACKGROUND

Geography and Topography

The Iowa portion of the Upper Mississippi River drainage area involved in the first session of the water quality standards conference covers approximately the eastern two-thirds of the State of Iowa. It includes the Iowa part of the drainage areas of the Upper Iowa, Wapsipinicon, Cedar, Iowa (from its junction with the Cedar to the Mississippi), Des Moines, and Fox Rivers. The area is bounded on the west by the Des Moines and Fox River basins and on the east by the Mississippi River. Excluded from the conference are the drainage basins of four intrastate streams, the Turkey, Maquoketa, Skunk and Iowa (above its junction with the Cedar) Rivers. Included however is the direct drainage to the Mississippi River. The area involved, after exclusion of the intrastate basins, amounts to 24,900 square miles or 44 per cent of the land area of the State.

Mississippi River

The Mississippi River through the stretch adjacent to Iowa has been improved for commercial navigation, with a nine foot channel being maintained. The channel along this stretch is maintained by a series of locks and dams. Through this section of the River the stream velocities will vary from about two miles per hour at usual pool stages to about four miles per hour at high water.

The drainage area adjacent to the Mississippi River can be described as rugged terrain with steep bluffs. The minor tributaries have steep gradients. The flood plain varies from two to ten miles in width and has excellent alluvial soils providing the basis for extensive truck farming.

Upper Iowa River

The Upper Iowa River rises in southeastern Minnesota and flows in a southeasterly direction into northeast Iowa and then in an easterly direction to its confluence with the Mississippi River just south of the Iowa-Minnesota state line. The Iowa portion of its drainage area is approximately 1000 square miles or 2 per cent of the State of Iowa. As the River leaves the Iowan drift plains of its headwaters it flows across the resistant Galena dolomite in northeastern Howard County. In this reach, the river flows through a bluff-walled valley in which the flood plain is less than 300 feet wide. The stream flows through a number of canyon-like reaches where resistant formations are encountered throughout the remainder of its course. The slope of the channel decreases from an average of about six feet per mile to only two feet per mile in the lower 20 miles. In this lower reach there has developed a flood plain from one-half to one mile in width and

the river flows a meandering course, filling its mouth with sediment. The mouth of the river is lost in a network of lakes and sloughs along the western bank of the Mississippi River in northern Allamakee County.

Wapsipinicon River

The Wapsipinicon is the largest and longest of the rivers in northeast Iowa. It rises in southeastern Minnesota at an elevation of 1,250 feet and flows southeastward for a distance of 225 miles to its confluence with the Mississippi River at an elevation of 565 feet, 12 miles below Clinton. The Iowa part of its drainage area is approximately 2,500 square miles or 4+ per cent of the State of Iowa.

The Wapsipinicon River basin is very narrow, averaging only 10 miles in width with a maximum width of 20 miles in Clinton and Scott Counties. Throughout most of its length, the Wapsipinicon River flows through young glacial plains which have undergone only slight erosion. The upper basin is a typical drift prairie stream flowing through broad sags not very much depressed below adjacent plains. Downstream the valley becomes deeper but in only a few places approaches the rugged aspect of other northeastern Iowa streams. The valley is as much as two to three miles wide in some areas. Where resistant bedrock is crossed, canyon-like reaches appear where the valley is less than one-half mile wide. These canyon-like reaches are interspersed with long reaches where the flood plain is wide and the valley is flanked by low, rolling hills. The Wapsipinicon River forms the border between Clinton and Scott Counties where it meanders sluggishly through a valley three to four miles wide to the mouth.

Iowa and Cedar Rivers

The Cedar River rises in marshy depressions in the lake region of southern Minnesota. Draining an area of 7,870 square miles, with about 1,050 square miles in Minnesota, it flows in a southeasterly direction from southcentral Minnesota through east-central Iowa and joins the Iowa River at Columbus Junction in southeastern Iowa, about 30 miles from the Mississippi River.

Generally, the Iowa-Cedar basin is gently rolling prairie land, with surface elevations less than 150 feet above the streams. All the basin was covered by deposits of the two earliest ice sheets, the Nebraskan and Kansan. In the lower part of the basin, except in parts of Louisa and Muscatine Counties, the surface deposits are from the Kansan ice sheet, which cover those of the Nebraskan and provide a surface that is maturely drained and susceptible to erosion. The surface deposits in parts of Louisa and Muscatine Counties are from the Illinoian, the third ice sheet, and the topography is also mature. The streams have cut deeply into the Kansan and Illinoian deposits, and wide flood plains are common.

In the eastern part of the basin and north of the Benton-Iowa County line, surface deposits are of the Wisconsin Stage of glaciation. Although

fairly wide flood plains are sometimes developed, the streams in this region are generally in steep valleys. Isolated lakes, swamps, and bogs are found in the upper reaches. In the upper western part of the basin, which includes the upper Iowa drainage, surface deposits are from the latest glacial stage, the Wisconsin. Morainic hills, marshes, and peat bogs characterize the topography. Streams flow in shallow channels in upper reaches, but cut channels deeper into the glacial till and often into rock in lower reaches.

Des Moines River

The Des Moines River basin forms the west-central border of the Upper Mississippi River basin in Iowa, with the upper tip of the basin extending into Minnesota. The basin is relatively long and narrow with an average width of 40 miles compared to a length of 360 miles. The Des Moines River rises in the northwestern corner of Murray County, Minnesota at an elevation of about 1,900 feet and flows in a southerly direction, entering Iowa at the northwestern corner of Emmet County. After entering Iowa, the river flows in a southeasterly direction 535 miles to a junction with the Mississippi River a few miles below Keokuk, Iowa, at an elevation of 476 feet. The total area drained by the River is 14,540 square miles, of which 1,525 are in Minnesota, 12,925 in Iowa, and 90 in Missouri. The area drained in Iowa comprises 23 per cent of the total area of the State.

The entire course of the river is across a region which in past ages was covered with continental glaciers. The mantle in this region is therefore composed of material carried by the glaciers and left there after they melted. Below Des Moines the mantle is composed of loess-covered drift. Beneath the glacial deposits the bedrock consists of various layers of stone. In the upper part of the valley, this bedrock has not been exposed by the action of the river, but below Humboldt, outcrops are common.

Above Des Moines, the valley is narrow and in the extreme upper parts is shallow. Below Humboldt to Des Moines the hills on either side of the river are high and steep while below Des Moines the valley becomes wider and is bounded by rounded bluffs, until the stream enters the Mississippi River flood plain. The valleys of the East Fork Des Moines, Boone, and the Raccoon Rivers have the same general characteristics as the main stream above Des Moines.

Fox River

The Fox River rises in Appanoose County in the extreme southeastern part of Iowa and flows easterly through Davis and Van Buren Counties then southeasterly through northwestern Missouri to its confluence with the Mississippi River. The Iowa portion of its drainage area is less than 0.4 per cent of the area of the State. The upland area is used primarily for agricultural purposes and its topography ranges from level prairie to rolling country to steep hills.

Climate

The climate of the area can be described as varying from a typical continental climate on the west to a humid continental climate along the Mississippi River. The mean annual temperature is about 48°F. The area has a wide temperature range, from in excess of 110°F. to extreme low readings of more than 40°F. below zero. The average January temperature ranges from 12-14°F. in the north to 24°F. in the south. Average July temperature ranges are 73-86°F. in the north and 77-90°F. in the south with the higher temperatures occurring along the Mississippi River.

The average precipitation over the area is 32-33 inches per year. This ranges from 28-32 inches, along the northern part to 36 inches in the south. About 70 per cent of the mean annual total occurs during the frost free growing season, providing for satisfactory crop growth.

Population and Industry

The economic study area, which includes the counties of the Des Moines, the counties of the Turkey-Maquoketa-Wapsipinicon, Upper Iowa and Cedar River basins and Louisa County of the Iowa River basin had a 1960 total population of 1.9 million and a non-farm population of 1.4 million. The total population was divided among the three principal subbasins approximately as follows: Des Moines River basin, 45 per cent; Turkey, Maquoketa-Wapsipinicon and Upper Iowa, 25 per cent; Cedar River basin (plus Louisa County), 30 per cent. Total manufacturing employment in 1960 was approximately 134,000, with 47,000 being in the Des Moines River basin, 43,000 in Cedar River basin, and 44,000 in the Turkey-Wapsipinicon and Upper Iowa River basins. The food and kindred products industry, including a substantial meat packing industry, employed about 42,000 in the combined area. Cattle and calves on farms in the study area totaled about 3.9 million; hogs and pigs about 7.5 million.

Des Moines River Basin

Within the Des Moines River basin, Polk County, which includes the city of Des Moines, is the most populous county and had a 1960 population of 266,000; the city of Des Moines had a 1960 population of 209,000. There are six other cities (including Keokuk and Ft. Madison on the Mississippi River) over 10,000 in population. Manufacturing employment is widely distributed throughout the area, the greatest concentrations are in Polk (22,860); Wapello (5,070); and Webster (4,390) counties in Iowa. Employment in food industries in the area, including meat packing, totaled almost 13,000; employment in the chemical industries, about 1,400. Farm activities are substantial in the area. Cattle and calves on farms in 1964 totaled about 1.6 million; hogs and pigs about 3.1 million.

Cedar River Basin

Within the Cedar River basin (and within the State of Iowa) three counties, Linn, Cerro Gordo, and Blackhawk, each had a 1960 population of 40,000 or more. Cedar Rapids (Linn County) and Waterloo (Blackhawk County) are the largest cities with 1960 populations of about 92,000 and 72,000, respectively. Three other cities in the Iowa portion of this basin had a 1960 population of 10,000 and over. Of the 43,000 persons employed in manufacturing in the Cedar River basin, about 16,000 were employed in the food industry, including meat packing. The greatest concentrations of manufacturing employment are in Linn, Blackhawk, Muscatine, and Cerro Gordo counties. Cattle and calves on farms totaled about 1.0 million; hogs and pigs about 2.0 million.

Other Basins

Within the Turkey, Maquoketa, Wapsipinicon and Upper Iowa River basins, the four largest cities in 1960 and their populations were: Davenport (88,981), Dubuque (56,606), Clinton (33,589) and Bettendorf (11,534). Manufacturing employment totaled approximately 43,000 in 1960 with the greatest concentration in Scott, Dubuque, and Clinton counties. Employment in the food industry was about 20,000 including substantial employment in meat packing. Cattle and calves on farms in 1964 totaled about 1.3 million; hogs and pigs about 2.4 million.

About one-fourth of the total population and about 40 per cent of the manufacturing employment of the combined study area is in counties bordering on the Mississippi River - mostly in Scott, Dubuque, Clinton, Lee and Muscatine counties.

The Upper Mississippi River has long been one of the nation's leading inland waterway systems in terms of traffic importance to the surrounding tributary area. The growth in number and size of port cities including Dubuque and Davenport-Rock Island-Moline is directly related to the economic value of the Upper Mississippi River and the natural facilities for water-borne commerce that it provides. The growth in tonnage for all commodities from 8.7 million tons in 1947 to 45.7 million tons in 1964 represents more than a fivefold increase during that period.

Hydrology

The streams considered in this report exhibit a wide range of flow regimens. Table I shows the flow characteristics of streams involved, as determined from the gaging station records. Waste treatment requirements must be designed for low flow periods in order to avoid fish kills and other undesirable effects.

TABLE I

FLOW DATA

LOCATION	DRAINAGE AREA ABOVE (SQ.MI.)	STATION YEARS OF RECORD	AVERAGE DISCHARGE (CFS)	INSTANTANEOUS FLOWS FROM STATION YEARS OF RECORD		YEARS OF RECORD USED TO COMPUTE LOW FLOWS	7 DAY AVG. 1 IN 10 YEARS (CFS)	1 DAY IN 30 YEARS (CFS)
				MINIMUM FLOW(CFS)	MAXIMUM FLOW(CFS)			
Mississippi River - Main Stem								
McGregor, Iowa	67,500	31	32,210	6,200	276,000	1938-1967	8,650	6,780
Clinton, Iowa	85,600	94	46,910	6,500	307,000	1874-1967	9,800	7,300
Keokuk, Iowa	119,000	89	61,100	5,000	327,000	1878-1967	11,200	7,700
Upper Iowa River								
Upper Iowa River at Decorah	511	32	264	22	20,200	1934-53	23	10
Wapsipinicon River								
Wapsipinicon River near Elma	95.2	8	52.0	1.9	5,700	-	-	-
Wapsipinicon River at Independence	1,048	33	523	7	21,500	1934-59	12	7
Wapsipinicon River near DeWitt	2,330	32	1,344	70	26,000	1935-59	90	70

TABLE I
(continued)
FLOW DATA

LOCATION	DRAINAGE AREA ABOVE (SQ.MI.)	STATION YEARS OF RECORD	AVERAGE DISCHARGE (CFS)	INSTANTANEOUS FLOWS FROM STATION YEARS OF RECORD		YEARS OF RECORD USED TO COMPUTE LOW FLOWS	7 DAY AVG. 1 IN 10 YEARS (CFS)	1 DAY IN 30 YEARS (CFS)
				MINIMUM FLOW(CFS)	MAXIMUM FLOW(CFS)			
Iowa-Cedar River								
Iowa River near Lone Tree, Iowa	4,293	10	2,486	75	31,200	1956 - 1966	100.	30.e
Iowa River at Wapello, Iowa	12,499	52	6,253	300	94,000	1933 - 1966	540.	315.
Cedar River at Janesville, Iowa	1,661	46	721	28	37,000	1948 - 1966	70.	40.e
Shellrock River near Northwood, Iowa	300	21	123	0.3	3,400	1948 - 1966	3.1	0.0e
Winnebago R.(Lime Cr.) at Mason City, Iowa	526	34	221	2.5	10,800	1933 - 1966	7.0	2.8
Shellrock River at Shellrock, Iowa	1,746	13	732	39	33,500	1953 - 1966	55.	23.e
Cedar River at Waterloo, Iowa	5,146	26	2,554	152	76,700	1943 - 1966	230.	140.e
Cedar River at Cedar Rapids, Iowa	6,510	64	3,094	212	73,000	1933 - 1966	300.	215.
Cedar River near Conesville, Iowa	7,785	27	4,050	250	70,800	1940 - 1966	400.	125.e

e = Flow estimated by extrapolating curve of available flow data to this recurrence interval.

TABLE I
(continued)
FLOW DATA

LOCATION	DRAINAGE AREA ABOVE (SQ.MI.)	STATION YEARS OF RECORD	AVERAGE DISCHARGE (CFS)	INSTANTANEOUS FLOWS FROM STATION YEARS OF RECORD		YEARS OF RECORD USED TO COMPUTE LOW FLOWS	7 DAY AVG. 1 IN 10 YEARS (CFS)	1 DAY IN 30 YEARS (CFS)
				MINIMUM FLOW(CFS)	MAXIMUM FLOW(CFS)			
Des Moines River								
Des Moines River @ Keosauqua, Iowa	14,038	57	5,254	40(1)	146,000	1912-62	124	46
Des Moines River @ Ottumwa, Iowa	13,374	49	4,768	30(1)	135,000	1917-59	102	30
Des Moines River Nr. Tracy, Iowa	12,479	46	4,330	40(1)	155,000	1920-59	125	70
Des Moines River Below Raccoon River @ Des Moines, Iowa	9,879	26	3,861	55(1)	77,000	1940-62	80	50
Des Moines River Nr. Boone, Iowa	5,511	46	1,658	17(1)	57,400	1920-62	40	15
Des Moines River @ Fort Dodge, Iowa	4,190	34	1,334	14(1)	35,600	1947-59	30	0
West Fork Des Moines R. @ Estherville, Iowa	1,372	15	271	0	10,800	1951-62	0	0
Fox River								
Bloomfield, Ia.	87.7	9	45.9	0	8,600	-	-	-
Wayland, Mo.	400	44	219	0	25,000	1922-1966	0	0

(1) Average daily flow

Mississippi River

The Mississippi River in the stretch adjoining Iowa is characterized by well sustained low flows. This is due in part to its large drainage area and the storage effect of the numerous locks and dams. There are 11 locks and dams in this stretch from Lock and Dam No. 9 at Lynxville, Wisconsin to No. 19 at Keokuk, Iowa. Intermediate locks and dams are located, proceeding from upstream to downstream, at Guttenberg, Dubuque, Bellevue, Clinton, Le Claire, Davenport, Muscatine, Port Louisa, and Burlington, Iowa.

The 7-day average one-in-10-year low flow varies from 8,650 cfs (cubic feet per second) at McGregor, Iowa, to 9,800 cfs at Clinton, to 11,200 cfs at Keokuk. The average flows at these same locations are 32,210 cfs, 46,910 cfs, and 61,100 cfs, respectively.

Upper Iowa and Wapsipinicon Rivers

The Upper Iowa and Wapsipinicon Rivers rise in the Iowan drift plains where drainage is sometimes slow and the subdued topography is not conducive to high runoff rates. However, the larger part of the Upper Iowa drainage basin is located in the rolling to rough topography of the Kansan or "driftless" areas where the mature topography, narrow valleys, and steep slopes give rise to rapid runoff, flash flooding and rapid recession of floodwaters. The Wapsipinicon differs from the Upper Iowa in that it drains a long and narrow basin with relatively little dissection of the tributary streams, as compared to the fan shaped drainage area of the Upper Iowa. Being long and narrow the probability of concentrated storms being oriented to cover a large part of the basin is reduced, resulting in reduced flood peaks and less rapid runoff.

High flows on the rivers are caused by rains falling on saturated or frozen ground in later winter or early spring, often simultaneous with spring thaws. High flows have also resulted from unusually severe thunderstorms following previous storms which have saturated the ground.

The rivers exhibit good low flow characteristics with the discharge from shallow groundwater reservoirs providing a considerable portion of the flow during these periods. The discharge from this source is believed to be appreciable when stream flows are at a minimum, generally during late summer or early fall and in mid-winter.

Iowa and Cedar Rivers

The Cedar River rises in the lake region of southern Minnesota and along with the Iowa River drains northcentral and southeastern Iowa. The Cedar River joins the Iowa River at Columbus Junction in southeastern Iowa, about 30 miles from the Mississippi River. The Shellrock River, which originates at Lake Albert Lea in Minnesota and drains 2,660 square miles, is the largest tributary of the Cedar River. The principal tributaries of the Shellrock River are the West Fork of the Shellrock River (draining 860 square miles) and the Winnebago River (Lime Creek) (draining 705 square miles).

The drainage area of the Iowa River between the confluence of the Iowa and Cedar Rivers and the Mississippi River is about 395 square miles.

The Cedar River has an average slope of 2.5 feet per mile. At Wapello, near its mouth, the Iowa River has a bankfull capacity of 29,000 cubic feet per second, a width of about 740 feet, and a mean depth of 10.7 feet. At Cedar Rapids, the Cedar River has a bankfull capacity of 10,000 cubic feet per second, a width of 485 feet, and a mean depth of 5.1 feet.

The average annual runoff is about 6.64 inches, with 3.91 inches occurring during the growing season. However, the total annual runoff shows considerable variation. In 1910, a dry year, it was 4.01 inches, with 1.38 inches occurring during the growing season. In 1951, a wet year, it was 13.47 inches, with 9.88 inches occurring during the growing season. Stream flows at individual gaging stations are highly variable, with maximum flows that are many times the average and minimum values. A considerable amount of the flow of perennial streams is caused by ground water discharge. This tends to provide natural supplementation during low flow periods.

Des Moines River

The Des Moines River and its tributaries are characterized by great variations in flows as shown in Table 1. Much channel straightening and drainage work in the upper reaches and the intensive cultivation of the land has created a highly turbid, nutrient rich stream. Stream flow records show that the Des Moines River and its tributaries have poor sustained low flows, and serious flooding occurs rather frequently. The 49-year average flow on the Des Moines River at Ottumwa is 4,768 cfs. In 1940, an extremely dry year, the daily flow varied from a minimum of 30 cfs to a maximum of 12,760 cfs. Low flows in this basin generally occur during the summer, fall and winter months and some tributaries have approached or reached no flow conditions during periods of extended drought.

Two dams are currently under construction on the Des Moines River in Iowa. These two projects are part of the Federal Comprehensive Plan for flood control and other purposes in the Upper Mississippi River basin.

The Saylorville Dam, located approximately 11 miles upstream from Des Moines, will have a 105.5 foot earth embankment, a flood control pool of 16,700 acres and a conservation pool of 5,400 acres. The Red Rock Dam is located approximately 60 miles downstream from Des Moines. This dam will consist of an earth embankment 110 feet in height with a flood control pool of 65,500 acres and a permanent lake of 8,950 acres. The Red Rock Dam is scheduled to be completed in 1969 and the Saylorville Dam and Reservoir in 1970.

In times of low flow in the Des Moines River, water will be released from the conservation pool of the Saylorville reservoir as needed to maintain a minimum flow of 200 cfs at the Second Avenue gage in Des Moines, and

a minimum flow of 300 cfs at Ottumwa. The minimum regulated flows will improve water supply, water quality and fish and wildlife habitat for downstream points.

Fox River

In its upper reaches in southeast Iowa, the gradient of the Fox River is slightly steeper than the fairly uniform slope which it has throughout the greater part of its course. The Fox River channel has been improved from its headwaters to the Iowa-Missouri State line with construction of a pilot channel which has subsequently deepened as much as 20 to 30 feet in the upper reaches. This channelization was not carried into Missouri and as a result, in the lower reaches of the improvement, many acres of cultivated land have become untillable due to sediment deposition.

The tendency of the stream flow is to be erratic. The stream flow extremes are caused by the wide annual precipitation variation. At the Wayland gaging station located closest to the mouth of the river, the flow has ranged from zero to 25,000 cfs for 44 years of record. The average flow at the station for the period of record was 219 cfs. There were periods of zero flow, which are of prime concern in pollution control, during 9 of the 44 years of record on the Fox.

Existing Waste Sources

The Iowa portion of the combined drainage area of the Upper Iowa, Wapsipinicon, Iowa-Cedar, Des Moines, and Fox Rivers includes 189 municipal sewage treatment plants. These plants serve a 1960 population of 781,695. In addition to the wastes for this population served, these river basins generate an industrial waste load before treatment equivalent to 2,138,820 "population equivalent" (P.E.). A "population equivalent" (P.E.) describes the pollutional effect of various waste discharges in terms of a corresponding effect of discharging raw sewage from an equivalent number of human population. Each P.E. represents the equivalent of wastes contributed by one person in a single day. Part of this load is handled by municipal treatment plants and part by the industries themselves. Table 2 shows the waste loadings on a river basin level. Only those treatment plants that are in the various river basins are shown.

TABLE 2

WASTE LOADINGS BY RIVER BASIN

River Basin	Number of Systems	Population Served 1960	Estimated Industrial Waste Load Before Treatment (PE)	Estimated Total Waste Load Before Treatment (PE)	Estimated Total Waste Load After Adequate Treatment (PE) *
Upper Iowa	3	10,000	1,000	11,000	2,350
Wapsipinicon	22	33,910	67,170	101,080	15,200
Iowa-Cedar	60	301,180	1,284,150	1,585,330	238,000
Des Moines	103	434,205	785,900	1,220,105	183,000
Fox	1	2,400	600	3,000	450
Total	189	781,695	2,138,820	2,920,515	439,000

* Assuming adequate treatment of at least 85% reduction by 1972 as called for in Iowa's Implementation Plan.

With the completion of Iowa's Implementation Plan by 1972 all of these plants and industrial loads will have adequate treatment and the total load will be reduced from 2.9 million P.E. to 0.44 million.

Table 3 presents an inventory of the municipal waste treatment facilities that discharge directly to the interstate streams of Iowa. Table 4 summarizes the inventory.

Along the Mississippi River, there are 18 communities that have municipal waste treatment facilities as shown in Table 5. Of this total the two communities of Lansing and Marquette have no treatment. The remaining communities are serviced by 13 primary treatment plants and 3 secondary treatment plants. Primary treatment is the removal of settleable solids from sewage and industrial waste. Primary treatment plants generally remove 25-35% of the biochemical oxygen demand (BOD) and 45-65% of the suspended solids. Secondary treatment plants use biological processes and generally remove 80-95% of both BOD and suspended solids. Biochemical oxygen demand is a measure of the oxygen demand of sewage and industrial waste. The estimated population served by these 18 municipalities is 267,075. The estimated P.E. of the waste loads discharged from these municipalities and from their industries which discharge directly

TABLE 3

INVENTORY OF MUNICIPAL WASTE FACILITIES

Municipality	Estimated Population Served	Treatment Primary (P) or Secondary(S)	Average Daily Flow (mgd)	Estimated Waste Load Before Treatment (P.E.)	Estimated Waste Load After Treatment (P.E.)
Municipal Discharges to Cedar River					
Cedar Falls	20,500	S	2.540	25,000	3,750
Cedar Rapids	110,000	S	14.430	674,000	38,100
Charles City	8,250	S	1.600	15,000	2,250
Janesville	580	S	0.030	580	85
Nashua	1,100	S	0.050E	1,100	165
Palo	300	S	0.030E	300	45
Plainfield	400	S	(applied to land)		
Vinton	4,000	S	0.300	4,500	450
Waterloo	65,000	S	21.000	650,000	70,000
Waverly	5,500	S	0.600	50,000	7,000
Municipal Discharges to Shellrock River					
Clarksville	1,200	P	0.060	1,200	900
Greene	1,200	S	0.150E	1,900	380
Nora Springs	1,000	S	0.150	2,200	400
Northwood	1,500	S	0.150	2,000	300
Shellrock	1,000	S	0.090	1,000	150
Municipal Discharges to Winnebago River (Lime Creek)					
Forest City	2,700	S	0.400E	4,000	600
Leland	150	S	0.015E	150	25
Mason City	30,000	S	2.667	55,000	5,000
Municipal Discharges to Iowa River					
Columbus Junction	600	None	0.070E	700	700
Wapello	1,290	S	0.300E	1,300	195
Municipal Discharges to Des Moines River					
Des Moines	217,000	S	16.450	450,000	22,500
Eddyville	900	S	0.130E	900	135
Eldon	800	None	0.080E	800	800
Fort Dodge	27,000	S	2.400	90,000	4,500
Keosaqua	700	S	0.100E	1,000	150
Lehigh	700	S	0.050E	700	100
Ottumwa	35,000	P	5.1 E	560,000	360,000
Pleasant Hill	990	S	0.100E	990	100

TABLE 3

INVENTORY OF MUNICIPAL WASTE FACILITIES
(continued)

Municipality	Estimated Population Served	Treatment Primary (P) or Secondary(S)	Average Daily Flow (mgd)	Estimated Waste Load Before Treatment (P.E.)	Estimated Waste Load After Treatment (P.E.)
Municipal Discharges to East Fork at the Des Moines River					
Algona	5,200	S	0.400	6,000	900
Armstrong	700	S	0.100E	1,000	150
Dakota City	630	S	0.060E	630	95
Municipal Discharges to West Fork of the Des Moines River					
Emmetsburg	3,700	S	0.200	4,500	700
Estherville	7,500	S	2.000	85,000	6,000
Graettinger	600	S	0.240E	1,200	180
Humboldt	3,500	S	0.400E	5,000	700
Municipal Discharges to the Fox River					
Bloomfield	2,400	S	0.324	3,000	400
Municipal Discharges to Upper Iowa River					
Decorah	6,000	S	0.518	6,500	1,000
Lime Springs	500	S	0.050E	500	100
Municipal Discharges to Wapsipinicon River					
Anamasa	4,300	S	0.500	7,000	1,050
Central City	950	S	0.100E	1,000	150
Independence	5,000	S	0.300	6,000	900
Olin	500	S	0.080E	800	120
Oxford Junction	400	S	0.060E	600	90
Tripoli	1,000	S	0.120	1,400	200
Troy Mills	250	P	0.025E	250	150
Riceville	700	S	0.100E	1,000	150

E = Estimated

TABLE 4

SUMMARY OF MUNICIPAL WASTE FACILITIES

River	Estimated Population Served	Treatment P	Treatment S	Average Daily Flow (mgd)	Estimated Waste Load Before Treatment (P.E.)	Estimated Waste Load After Treatment (P.E.)
Upper Iowa	6,500	0	2	0.568	7,000	1,100
Wapsipinicon	13,100	1	7	1.285	18,050	2,810
Cedar	215,630	0	10	40.580	1,420,480	121,845
Shellrock	5,900	1	4	0.600	8,300	2,130
Winnebago(Lime)	32,850	0	3	3.082	59,150	5,625
Iowa	1,890	0	1	0.370	2,000	895
Des Moines	283,090	1	6	24.410	1,104,390	388,285
E. Fork Des Moines	6,530	0	3	0.560	7,630	1,145
West Fork Des Moines	15,300	0	4	2.840	95,700	7,580
Fox	2,400	0	1	0.324	3,000	400
Total	583,190	3	41	74.619	2,725,700	531,815

P = Primary
S = Secondary

TABLE 5

WASTE DISCHARGES TO MISSISSIPPI RIVER
INCLUDING MUNICIPAL AND INDUSTRIAL WASTES

Municipality	Estimated Population Served	Treatment Primary (P) or Secondary(S)	Estimated Waste Load Discharged to River (P.E.)
Bellevue	1,900	P	1,235
Bettendorf	11,000	Davenport	
Buffalo	900	P	600
Burlington	31,000	P	16,000*
Camanche	2,200	P	1,430
Clinton	30,000	P	302,000*
Davenport	80,000	P	210,000*
Dubuque	56,000	P	304,000
Fort Madison	14,500	P	165,000*
Keokuk	15,000	P	240,000*
Lansing	1,200	None	1,200
Le Claire	1,350	P	900
Marquette	550	None	550
McGregor	1,000	P	650
Montrose	375	P	310
Muscatine	17,000	P	300,000*
New Albin	600	S	100
Princeton	500	S	75
Sabula	800	S	120
West Burlington	1,200	Burlington	
Total	267,075		1,542,870

*Estimates from State of Iowa, other figures from Municipal Waste Treatment Facility Inventory

into the Mississippi is 1,542,870. It is estimated that secondary sewage treatment and its industrial equivalent would result in a waste loading to the Mississippi of a P.E. of approximately 250,000. The reduction in wastes with secondary treatment would amount to the equivalent of the raw wastes of 1,300,000 persons each day.

Existing Water Quality

The water quality of the Mississippi River and the other interstate rivers described in this report varies depending upon the topography of the drainage areas, agricultural land use, flow conditions, and point sources of wastes. Erosion is significant in some areas and results in increased turbidity in the streams. The intense agricultural use in some areas is reflected by relatively high concentrations of coliform bacteria, and total nitrogen and phosphate levels. High bacteria counts and low dissolved oxygen levels occur and create problems near points of waste discharge as well as other areas during periods of low flow and at other times.

Many of these existing conditions which adversely affect water quality could be reduced or eliminated by adequate treatment of wastes and by good farming practices to reduce the large quantities of sediment and nutrients reaching the streams.

Mississippi River

The existing water quality of the Mississippi River is somewhat variable depending upon flow conditions, relative location with respect to population areas (waste sources) and the topography of the drainage areas. Table 6, prepared from published State data, shows the chemical quality of surface waters at Keokuk, Ft. Madison, Burlington, Davenport, Clinton, and Dubuque. The FWPCA has operated two water quality monitoring stations on the Mississippi River at Dubuque and Burlington since December 12, 1957, and October 28, 1957, respectively. Table 7 summarizes most of the data collected at these two stations.

The water quality, based upon the concentration of certain minerals used in the determination of water quality is generally within acceptable criteria for public water supplies. The hardness of the Mississippi River increased from a mean of 143 mg/l at Dubuque to a mean of 172 mg/l at Burlington, an increase of 21 per cent. A moderately hard water is sometimes defined as having a Hardness between 60 to 120 mg/l. Chloride concentrations increased from a mean of 7.9 mg/l at Dubuque to a mean of 8.9 mg/l at Burlington. Chloride concentrations are well within the desirable criteria of less than 25 mg/l recommended for public water supplies by the National Technical Advisory Committee on Water Quality.

The mean pH is within the range of 6.0 - 8.5 recommended by the Committee on Water Quality for public water supplies. One of the most aesthetically displeasing conditions of the Mississippi River occurring sea-

TABLE 6

CHEMICAL QUALITY OF IOWA STREAMS 1/

River	Location	Total Solids mg/l	pH	Chloride mg/l	Ammonia NH_3 mg/l	Nitrate NO_3 mg/l	Total Susp. S mg/l	Total PO_4 mg/l	COD mg/l
Cedar	Cedar Rapids	300-730	8.0-8.5	8-30	0.0-1.1	0.2-3.8	20-420	1.1-2.0	20-60
Des Moines	Ottumwa	460-3000	7.8-8.4	6-40	0.0-9.5	0.2-4.0	20-2500	0.8-4.6	20-180
	Des Moines	540-860	7.8-8.2	5-40	0.0-0.7	1.2-4.8	10-540	0.8-1.8	10-60
	Fort Dodge	450-1100	7.6-8.1	5-40	0.0-0.9	1.2-4.0	10-790	0.5-3.3	10-120
Iowa	Iowa City	370-530	7.6-7.9	3-20	0.0-1.4	0.2-2.9	10-380	0.1-2.0	10-60
	Marshalltown	390-870	7.7-8.2	6-20	0.0-0.3	0.1-6.3	10-490	0.6-2.2	10-70
Mississippi	Keokuk	230-400	7.7-8.1	4-10	0.2-0.7	0.5-1.8	10-220	0.3-1.4	20-40
	Ft. Madison	260-830	7.7-8.1	3-10	0.1-1.1	0.3-2.1	10-650	0.3-2.4	30-60
	Burlington	230-370	7.6-8.2	3-10	0.0-0.6	0.2-1.4	20-180	0.4-1.2	20-40
	Davenport	220-370	7.5-8.2	5-10	0.0-0.9	0.2-1.5	10-200	0.3-1.4	20-50
	Clinton	200-300	7.5-8.2	2-10	0.0-0.6	0.2-1.0	10-100	0.3-1.0	20-40
	Dubuque	250-300	7.6-8.0	4-10	0.0-0.6	0.3-0.6	10-100	0.3-1.1	20-30

1/ SOURCE: Water Quality Criteria and Plan for Implementation and Enforcement for the Surface Water of Iowa, Iowa Water Pollution Control Commission, State Department of Health, Des Moines, 1967.

TABLE 7
SUMMARY OF FWPCA WATER QUALITY DATA
MISSISSIPPI RIVER AT DUBUQUE AND BURLINGTON IOWA

PARAMETERS	DUBUQUE*					BURLINGTON**				
	n	Period	Max.	Min.	Mean	n	Period	Max.	Min.	Mean
Dissolved Oxygen, MG/L	344	57-68	17	0.7	7	32	57-58	18	5.7	11.3
pH, Std. Units	361	57-68	9	7	8	56	57-58	8.8	7.2	8
Chloride, MG/L	356	57-68	12	4	8	136	57-68	20	2	9
Total Alkalinity $CaCO_3$, MG/L	362	57-68	192	77	126	142	57-68	190	76	143
Total Hardness $CaCO_3$, MG/L	362	57-68	198	84	143	142	57-68	248	76	172
Color, Units	319	57-68	260	15	57	136	57-68	240	5	47
Turbidity, Jackson Units	328	57-68	290	10	54	133	57-68	300	4	42
Coliform DLY ENDO, MF/100 ML	315	57-68	100,000	1	284	140	57-68	250,000	40	6,475
BOD 5, MG/L	345	57-68	11	1.4	3	-	-	-	-	-
Sulfate, SO_4, MG/L	178	59-67	42	4	15	85	63-67	55	13	37
Total Sol. Phosphate PO_4, MG/L	215	59-67	0.6	0	0.19	37	63-64	0.3	0	0.08

n = Number of measurements.
*The sampling station at Dubuque is located on the west side of the Mississippi River near the Iowa-Illinois-Wisconsin borders. Samples are collected by the Corps of Engineers at Lock and Dam #11.
**The sampling station at Burlington is about 35 miles above the Missouri state line. Samples are collected from the municipal water intake.

sonally is the high turbidity caused by the sediment load carried by the River. The turbidity, attributable to suspended and colloidal matter, is the result of erosion of soil cover and the result of the addition of domestic sewage or wastes from industries. Measured in Jackson turbidity units, the recorded mean turbidity decreased from 54.5 at Dubuque to 42.3 at Burlington with maximums of 290 at Dubuque and 300 at Burlington. The decrease in mean turbidity is probably due to the pooling effects of the various dams on the River. The Committee on Water Quality recommends that turbidity in the receiving waters due to discharge should not exceed 50 Jackson turbidity units in warm water streams for fish and aquatic life.

The coliform count, which is used to evaluate the disease producing potential of the water reached a maximum of 100,000/100 ml at Dubuque and 250,000/100 ml at Burlington. At Davenport, unpublished State data shows that the coliform count has reached 72,000/100 ml. Although the mean coliform counts at Dubuque and Burlington are well within the permissible limits, the maximum counts at all three sampling points have exceeded the permissible criteria of 10,000/100 ml for public water supplies recommended by the Water Quality Committee.

Dissolved oxygen, for period December 2, 1957, to May 12, 1958, varied at Burlington from a high of 18 mg/l to 5.7 mg/l. At Dubuque, for period October 12, 1957, to August 30, 1968, varied from a high of 17 mg/l to a low of 0.7 mg/l. The recorded dissolved oxygen measurements at Dubuque were plotted for the period of record. Figure 1 shows that there has been a definite deterioration in dissolved oxygen content at Dubuque with measurements falling below the 8-hour minimum approved Iowa standard of 4 mg/l on many occasions from 1964 through 1967. The sampling station at Dubuque is located on the West side of the Mississippi River near the Iowa-Illinois-Wisconsin border. Samples are collected at the Corps of Engineers Lock and Dam #11. Low oxygen levels are an indication of the presence of amounts of oxygen-demanding organic wastes.

Wapsipinicon and Upper Iowa Rivers

The surface water quality of the Wapsipinicon and Upper Iowa Rivers reflect the predominantly agricultural nature of each basin. The Wapsipinicon River in many areas is quite scenic and has extensive recreation value. It is considered by the State Conservation Commission as one of the State's finest catfishing streams, and is also well stocked with walleye and smallmouth bass. There is little industrialization or large population centers along these streams to create pollution problems as serious as in other parts of the State. Erosion is significant in some areas and results in increased turbidity in the streams. The U. S. Geological Survey (USGS) records on the Upper Iowa River near Decorah for period 1962-1967 show daily sediment concentrations between a minimum of 1 mg/l on October 21, 1965, to a maximum of 8,700 mg/l on May 26, 1965, with a maximum total sediment load for water year 1965 of 384,217 tons. The high sediment load reflects the intense agricultural land use.

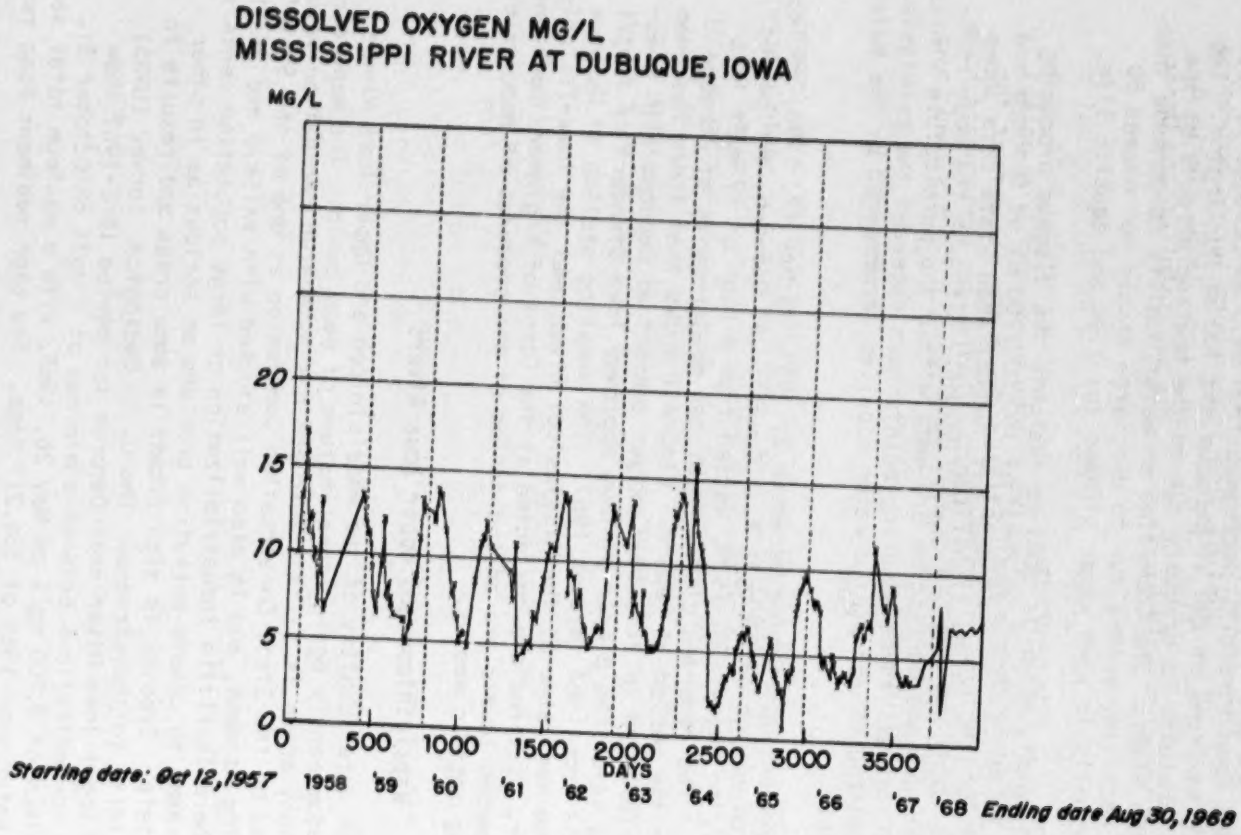
DISSOLVED OXYGEN MG/L
MISSISSIPPI RIVER AT DUBUQUE, IOWA
MG/L
20
15
10
5
0
0
500
1000
1500
2000
2500
3000
3500
DAYS
Starting date: Oct 12, 1957
1958
'59
'60
'61
'62
'63
'64
'65
'66
'67
'68
Ending date Aug 30, 1968

Figure 1

Water temperatures on the Upper Iowa at Decorah for period 1962-67 varied between a minimum of 32°F. on many days to a high of 87°F. on July 23, 26, 1967. On the Wapsipinicon River at Independence, temperatures varied between a minimum of 32°F. on many days to a high of 90°F. in June 1968 for water year October 1967 to September 1968. On the Wapsipinicon at DeWitt for period 1944-67, the temperature varied between a low of 32°F. on many days to a high of 92°F. in August 1955. Table 8 summarizes USGS temperature data by month on the Wapsipinicon and Upper Iowa Rivers.

During rainstorms, land runoff can increase the bacteriological content of the waters and also increases the nutrient content. Nutrients from fertilizer usage, which is extensive in the area, and from animal wastes are reaching the streams in quantities which are unknown at the present, but are believed to be significant. Studies on land runoff have shown that 10 to 25 per cent of the fertilizers applied to the land have been lost through drainage.

Des Moines River

The Des Moines River and its tributaries are characterized by great variations in flow, high sediment yields and point sources of waste discharge which affect water quality. High bacteria counts and low dissolved oxygen presently occur and create problems near points of waste discharge during periods of low flow. These problems will be reduced with the installation of adequate treatment and proper disinfection of wastes. Land runoff, channel straightening and drainage work, and intensive cultivation of the land have created a highly turbid nutrient rich stream.

Ottumwa is the only municipality that obtains its water supply from the Des Moines River. At Ottumwa, surface waters in the natural state are hard waters containing bicarbonate of calcium and magnesium ranging from 112 to 476 mg/l. The dissolved solids content ranges from 241 to 631 mg/l which at times exceeds the Public Health Service recommended contents of 500 mg/l. Table 6 shows the chemical quality of the surface waters published by the State Department of Health for Des Moines, Fort Dodge and Ottumwa.

The water temperature on the Des Moines River measured by the U. S. Geological Survey at eight locations varied between a minimum of 32°F. on many days at all stations to a high of 93°F. at Saylorville. Table 8 summarizes USGS temperature data by the month for each of the eight locations.

Cedar, Iowa, Shellrock, and Winnebago (Lime Creek) Rivers

The basic quality of surface waters reflects the extensive agricultural economy of the area. This basic water quality is further modified when surface streams receive waste discharges from the numerous municipalities and industries.

TABLE 8

SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4210	Wapsipinicon River at Independence Drainage Area: 1048 sq.mi. Flow (1933-1967) avg: 523 cfs max: 3340 cfs min: 48 cfs	67-68	n	31	29	31	30	31	30	31	31	31	1	2	31
			max	38	40	57	64	68	90	80	82	76	50	40	42
			min	32	34	37	49	58	59	69	68	63	50	39	36
			avg	36.2	37.2	44.3	56.8	61.5	75.5	76.5	77.6	70.5	50	39.5	38
5-4220	Wapsipinicon River at DeWitt Drainage Area: 2330 sq.mi. Flow (1934-1967) avg: 1344 cfs max: 3770 cfs min: 190 cfs	44-67	n	20	17	22	16	18	20	15	20	19	14	25	14
			max	35	38	42	69	73	84	84	92	80	68	50	34
			min	32	32	32	36	46	60	72	59	58	44	32	32
			avg	32.6	32.7	34.4	52.6	59.8	73.5	76.9	71.5	66.5	53.5	42.7	32.5
5-4577	Cedar River at Charles City, Iowa Drainage Area: 1054 sq.mi. Flow(1964-1966) avg: max: 21,000 cfs min: 100 cfs	65-66	n	2	2	2	2	2	1	1	2	1	-	3	3
			max	33	34	35	50	66	69	71	88	62	-	54	34
			min	32	32	33	42	62	69	71	84	62	-	33	34
			avg	32.5	33.0	34.0	46.0	64.0	69	71	86.0	62	-	42.3	34
5-4580	Little Cedar River near Ionia, Iowa Drainage Area: 306 sq. mi. Flow(1954-1966) avg: 124 cfs max: 10,800 cfs min: 3	62-66	n	5	5	5	5	5	4	4	5	4	4	5	5
			max	33	34	36	58	64	72	82	83	70	60	58	34
			min	32	32	32	41	49	62	74	70	62	51	40	32
			avg	32.6	32.6	33.8	48.6	60.6	66.5	78.8	78.2	66.3	55.5	46.8	33.6

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep.	Oct	Nov	Dec
5-4585	Cedar River at Janesville, Iowa Drainage Area: 1661 sq.mi. Flow(46 years) avg: 721 cfs max: 37,000 cfs min: 28 cfs	47-67	n	22	15	30	19	14	18	17	18	14	19	17	17
			max	34	35	46	64	72	76	84	86	78	68	56	45
			min	32	32	32	32	42	61	70	68	60	44	32	32
			avg	32.6	32.2	34.8	46.5	60.6	70.1	76.3	81.4	67.6	56.3	40.6	34.2
5-4589	West Fork Cedar River at Finchford, Iowa Drainage Area: 846 sq.mi. Flow (1945-1966) avg: 393 cfs max: 31,900 cfs min: 5.9 cfs	46-67	n	23	18	26	20	16	20	16	19	20	21	20	16
			max	34	38	45	62	72	79	86	95	82	64	55	46
			min	32	32	32	32	40	60	62	66	59	43	32	32
			avg	32.7	32.8	34.4	46.5	60.6	71.2	75.6	76.9	67.4	54.3	41.3	34.2
5-4590	Shellrock River near Northwood, Iowa Drainage Area: 300 sq.mi. Flow(1945-1966) avg: 123 cfs max: 3,400 cfs min: 0.3 cfs	47-67	n	19	19	22	19	16	15	19	18	16	17	15	13
			max	33	33	44	70	72	76	90	86	78	66	52	35
			min	32	32	32	34	45	62	61	61	52	44	32	32
			avg	32.2	32.2	34.1	45.2	60.1	69.5	74.3	75.6	65.9	54.9	39.5	32.5
5-4595	Winnebago River (Lime Creek) at Mason City, Ia. Drainage Area: 526 sq.mi. Flow(1932-1966) avg: 221 cfs max: 10,800 cfs min: 2.5 cfs	44-67	n	24	18	22	25	18	25	20	22	20	20	21	15
			max	44	42	46	64	70	76	81	87	74	64	61	43
			min	32	32	33	32	47	64	68	60	60	46	33	32
			avg	35.5	35.5	36.8	46.8	60.7	70.0	75.4	75.6	66.4	57.4	44.0	36.5

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4620	Shellrock River at Shellrock, Iowa Drainage Area: 1746 sq.mi. Flow(1953-1966) avg: 732 cfs max: 33,500 cfs min: 39 cfs	62-67	n	186	169	186	170	178	180	186	186	180	155	150	155
			max	35	35	49	57	68	72	77	74	70	60	51	44
			min	32	32	32	32	46	54	62	57	50	42	34	32
			avg	-	-	-	-	-	-	-	-	-	-	-	-
5-4630	Beaver Creek at New Hartford, Iowa Drainage Area: 347 sq.mi. Flow(1945-1966) avg: 172 cfs max: 18,000 cfs min: 2.3 cfs	62-66	n	5	4	5	5	5	4	4	5	5	4	5	5
			max	32	32	34	60	78	76	80	78	84	64	54	34
			min	32	32	32	36	53	61	75	65	60	52	39	32
			avg	32.0	32.0	33.6	45.8	61.6	67.8	77.5	71.6	71.0	58.3	46.0	32.4
5-4635	Blackhawk Creek at Hudson, Iowa Drainage Area: 303 sq.mi. Flow(1952-1966) avg: 138 cfs max: 9,000 cfs min: 1.9 cfs	62-66	n	4	5	5	5	5	4	4	5	4	4	3	5
			max	46	60	48	60	72	76	78	78	88	62	56	40
			min	32	32	32	34	45	61	75	70	64	54	38	32
			avg	36.0	40.6	36.4	46.8	57.8	70.0	77.0	73.6	72.3	59.5	45.7	35.4
5-4640	Cedar River at Waterloo, Iowa Drainage Area: 5,146 sq.mi. Flow(1940-1966) avg: 2,554 cfs max: 76,700 cfs min: 152 cfs	44-67	n	23	16	28	20	16	20	17	22	19	22	22	17
			max	37	38	48	64	70	76	82	88	76	64	55	46
			min	32	32	33	34	42	62	62	66	60	44	32	32
			avg	33.5	33.9	36.9	46.9	57.9	69.6	75.8	76.1	67.3	56.0	39.8	35.2

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4645	Cedar River at Cedar Rapids, Iowa Drainage Area: 6,510 sq.mi. Flow(1902-1966) avg: 3,094 cfs max: 73,000 cfs min: 212 cfs	44-67	n	19	19	21	20	19	18	18	18	15	24	19	24
			max	36	34	58	60	73	85	86	82	77	70	58	40
			min	32	32	32	34	46	57	65	69	56	37	32	32
			avg	33	33	38	47	61	78	76	77	67	57	41	34
5-4650	Cedar River near Canesville, Iowa Drainage Area: 7,785 sq.mi. Flow(1932-1966) avg: 4,050 cfs max: 70,800 cfs min: 250 cfs	46-67	n	14	23	21	15	17	15	14	18	12	16	25	20
			max	34	35	43	59	76	82	82	92	79	68	57	45
			min	32	32	32	34	47	56	65	63	61	44	32	32
			avg	32.5	32.8	35.8	44.5	58.1	70.9	77.4	76.7	70.3	56.4	43.8	34.3
5-4655	Iowa River at Wapello, Iowa Drainage Area: 12,499 sq.mi. Flow(1914-1966) avg: 6,253 cfs max: 94,000 cfs min: 300 cfs	44-67	n	20	17	24	17	15	15	16	18	12	18	24	16
			max	39	35	62	60	76	80	86	85	80	68	56	45
			min	32	32	32	33	48	63	63	72	59	45	32	32
			avg	33.4	32.9	37	49.2	63.2	70.9	75.8	78.2	68.8	57.1	41.6	34.4
5-4790	East Fork Des Moines River at Dakota City Drainage Area: 1308 sq.mi. Flow(1940-1967) avg: 471 cfs max: 3,080 cfs min: 14 cfs	54-67	n	17	17	19	16	14	13	17	16	10	15	20	11
			max	35	34	52	58	72	76	90	88	76	68	54	36
			min	32	32	32	33	51	49	61	61	51	44	32	32
			avg	32.5	32.3	34.1	46.2	58.7	67.8	75.5	74.4	65.9	56.8	39.4	33.4

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4805	Des Moines River at Fort Dodge Drainage Area: 4190 sq.mi. Flow(1905-1967) avg: 1317 cfs max: 12600 cfs min: 48 cfs	46-67	n	19	20	23	21	18	19	18	21	19	20	21	18
			max	36	35	54	64	74	77	90	90	80	65	51	40
			min	32	32	32	36	52	62	68	58	50	48	32	32
			avg	33.1	33.0	34.8	48.5	62.9	69.6	75.2	76.0	69.1	56.2	40.9	33.3
5-4815	Des Moines River near Boone Drainage Area: 5511 sq.mi. Flow(1920-1967) avg: 1647 cfs max: 17400 cfs min: 61 cfs	44-67	n	21	21	20	22	14	17	17	20	17	20	17	20
			max	33	34	42	64	78	80	90	89	85	76	54	36
			min	32	32	32	36	44	55	66	63	54	46	34	32
			avg	32.3	32.5	34.2	48.6	62.1	70.1	76.1	76.8	68.4	58.7	43.8	32.8
5-4816.5	Des Moines River near Saylorville Drainage Area: 5841 sq.mi. Flow(1961-67) avg: 2458 cfs max: 21,000 cfs min: 68 cfs	65-67	n	91	79	87	83	88	88	89	89	80	65	89	93
			max	36	38	55	62	80	84	92	88	85	71	60	43
			min	32	32	32	32	47	61	71	69	53	47	32	32
			avg	32.7	33.3	38.3	49.0	62.3	71.0	80.0	77.0	69.7	55.0	43.7	34.0
			(A maximum water temperature of 93°F occurred on July 22, 1964)												
5-4855	Des Moines River below Raccoon River at DesMoines Drainage Area: 9879 sq.mi. Flow(1940-1967) avg: 3806 cfs max: 38600 cfs min: 140 cfs	44-67	n	23	21	25	20	24	17	21	20	22	23	18	20
			max	35	36	48	64	75	84	87	93	78	68	58	37
			min	32	32	32	37	44	56	66	72	60	44	32	32
			avg	32.9	33.1	36.1	47.9	60.5	70.1	76.8	79.4	68.8	55.2	44.4	33.1

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4885	Des Moines River near Tracy Drainage Area: 12479 sq.mi. Flow(1920-67) avg: 4300 cfs max: 47400 cfs min: 160 cfs	44-67	n	20	16	24	15	19	17	18	20	16	21	18	18
			max	34	39	46	58	76	89	89	83	78	69	58	43
			min	32	32	32	36	52	51	70	68	56	42	33	32
			avg	32.4	30.9	36.1	46.1	66.1	73.1	78.3	75.7	67.7	53.2	44.1	34.2
5-4895	Des Moines River at Ottumwa, Iowa Drainage Area: 13374 sq.mi. Flow(1917-1967) avg: 4738 cfs max: 48600 cfs min: 160 cfs	44-67	n	19	29	24	13	17	14	14	19	16	21	18	23
			max	36	36	59	60	80	82	88	90	79	70	54	43
			min	32	32	32	33	51	60	67	61	50	41	33	32
			avg	32.7	33.1	37.8	47.5	64.5	72.6	78.6	75.5	68.6	57.0	41.5	34.2
5-4905	Des Moines River at Keosauqua Drainage Area: 14038 sq.mi. Flow(1903-1967) avg: 5223 cfs max: 49600 cfs min: 180 cfs	44-67	n	20	19	25	21	19	15	18	18	17	25	21	21
			max	34	36	65	60	78	84	88	84	81	69	58	40
			min	32	32	32	34	52	62	69	71	56	42	32	32
			avg	32.5	33.2	38.7	51.6	64.3	73.5	79.4	78.1	70.2	56.1	43.0	33.3
5-3875	Upper Iowa River at Decorah Drainage Area: 511 sq.mi. Flow(1951-1967) avg: 265 cfs max: 11800 cfs min: 42 cfs	64,66, 67	n	93	85	76	68	93	90	93	92	89	93	89	93
			max	32	32	50	62	80	83	87	82	76	66	54	44
			min	32	32	32	36	42	58	61	44	51	40	50	32
			avg	32	32	37	49	61	70	75	68	63	54	40	33

n = number of measurements
max = maximum
min = minimum
avg = average

1/ USGS, Iowa District

TABLE 9

COLIFORM AND TEMPERATURE DATA FOR NINE SELECTED STATIONS (1)

Station Location	Coliform MPN		Temperature Degrees Fahrenheit			
	max	min	max	date	min	date
Shellrock River,Outlet Lake Albert Lea	930,000	600	86.0	8/3/64	33.8	12/8/64 12/14/65
Shellrock River,Hwy.3 Bridge at Shellrock	>110,000	360	82.4	6/29/64 8/3/64	33.8	12/8/64 12/14765
Winnebago River (Lime Creek), Hwy.18 Bridge, Mason City	>110,000	13	87.8	8/3/64	33.8	12/8/64 12/14/65
Cedar River, Hwy.218 Bridge at Cedar Falls	110,000	24	84.2	7/15/63 6/29/64 8/3/64	33.8	12/8/64 12/14/65
Cedar River,R.R.Bridge at Cedar Rapids	160,000	24	87.8	6/30/64 8/4/64	32.0	12/9/64 12/15/65
Cedar River, Hwy.101 Bridge at Vinton	240,000	360	86.0	6/30/64 8/4/64	32.0	12/8/64 12/15/65
Cedar River, Old Hwy.1 Bridge at Rochester	460,000	<3000	84.2	7/17/63 7/1/64	32.0	12/10/64 12/16/65
Cedar River,County Park Bridge at Palo	43,000	730	87.8	6/30/64	32.0	12/15/65
Cedar River, Hwy.42 Bridge at Columbus Jnctn., confluence of Cedar and Iowa Rivers	240,000	3600	84.2	7/15/64 8/5/64	32.0	12/16/65

(1) 1963-65 Limnological Study by Iowa State Hygienic Laboratory.

> greater than
< less than

In 1963-1965 the Iowa State Hygienic Laboratory, as part of a Federally sponsored research grant, made an extensive study of the Cedar River from Albert Lea, Minnesota, to the confluence of the Iowa and Mississippi Rivers. For 24 measurements at nine selected stations, the ranges of coliform and temperature at each station are shown in Table 9. For all nine stations, the following range of measurements of selected water quality parameters were made:

Coliform Bacteria (MPN): Maximum of 930,000 on Shellrock River at outlet of Lake Albert Lea, Minnesota; minimum of 13 on Winnebago River (Lime Creek) at Mason City, Iowa,

BOD_5(5-day biochemical oxygen demand): Maximum of 15.2 mg/l at the outlet of Lake Albert Lea on the Shellrock River; minimum of 4.5 mg/l on the Winnebago River (Lime Creek) above Mason City,

COD/BOD_5 (ratio of chemical oxygen demand to 5-day biochemical oxygen demand): Maximum of 21.3 at the outlet of Lake Albert Lea on the Shellrock River; minimum of 8.1 on the Cedar River at Palo above Cedar Rapids (a high ratio of COD/BOD_5 is one measure of the presence of industrial wastes),

Total Algae: Maximum of 165,000 per ml on Shellrock River at outlet of Lake Albert Lea; maximum of 82,000 per ml on Cedar River at Palo above Cedar Rapids; minimum of 220 per ml on Cedar River at Columbus Junction,

Total Nitrogen (as nitrogen): Maximum of 5.7 mg/l at the outlet of Lake Albert Lea on the Shellrock River; minimum of 2.9 mg/l on the Cedar River above Waterloo,

Total Phosphate (PO_4): Maximum of 3.2 mg/l at the outlet of Lake Albert Lea on the Shellrock River; minimum of 0.9 mg/l on the Cedar River above Waterloo,

DO (dissolved oxygen): Maximum of 11.2 mg/l on Cedar River above Waterloo; minimum of 8.2 mg/l on Cedar River at Rochester,

Per cent Saturation of Dissolved Oxygen: Maximum of 122.1 per cent on Cedar River above Waterloo; minimum of 88.6 per cent on Cedar River at Rochester.

Temperature measurements at U. S. Geological Survey gaging stations are summarized in Table 8. The maximum temperature measurements shown for the Cedar, Iowa below the Iowa-Cedar confluence, Shellrock, and Winnebago (Lime Creek) Rivers are:

Cedar River	at Charles City,	88°F.
"	" at Janesville,	86°F.
"	" at Waterloo,	88°F.
"	" at Cedar Rapids,	86°F.
"	" near Conesville,	92°F.

Iowa River at Wapello,	86°F.
Shellrock River near Northwood,	90°F.
" " at Shellrock,	77°F.
Winnebago River (Lime Creek) at Mason City,	87°F.

The minimum temperature measurement at each station was 32°F.

The surface water quality from Iowa Public Water Supply Data in Table 10 shows the range of concentrations found in eight samples from each of three municipal water supplies.

TABLE 10

PUBLIC WATER SUPPLY DATA (BEFORE TREATMENT)

Water Quality Parameter	Cedar River at Cedar Rapids	Clear Lake at Clear Lake (headwaters of Lime Creek)	Iowa River at Iowa City
	(milligrams per liter)		
Total solids	284 - 517	216 - 300	302 - 576
Dissolved solids	235 - 362	190 - 284	261 - 404
Total iron (Fe)	.04 - .12	< .02 - .16	.04 - .28
Nitrate (NO_3)	2.7 - 15.9	0.1 - 8.6	0.9 - 13
Sulfate (SO_4)	32.1 - 62.1	9.5 - 27.8	37.9 - 78.1
Hardness as $CaCO_3$	180 - 284	150 - 208	212 - 332
Silicon dioxide (SiO_2)	0.4 - 13.8	1.0 - 16.0	1.1 - 18.4
Total alkalinity	123 - 224	144 - 192	150 - 260

< less than

For a 100 squale mile drainage area, the annual sediment yield is about 50 tons per square mile in the northwestern part of the basin, 200 tons per square mile in the northeastern part, and 650 tons per square

mile in the central and southern part. The Iowa River at Iowa City, Iowa, is located in the area of greatest sediment yield. For the 1966 water year at this location, the sediment concentration varied from 9 to 4,700 mg/l and the total sediment load for the year was 463,379 tons, although the sediment load is reduced by deposition in the Coralville Reservoir located above Iowa City.

The relatively high concentrations of total coliform bacteria, total nitrogen, and phosphates reflect the intense agricultural land use in the Cedar River basin, although municipal and many industrial waste discharges also contain high concentrations of these pollutants. Compounds of nitrogen and phosphate function as plant nutrients. During daylight hours, algae produce oxygen and this is shown by frequent measurements of dissolved oxygen concentrations that are above the saturation value. During periods of darkness, they use stream dissolved oxygen, and they may reduce dissolved oxygen concentrations to suffocating levels for fish life. The relatively high sediment loads, especially in the sourhern part of the basin, also reflect the intense agricultural land use. The relatively high ratio of chemical oxygen demand to 5-day biochemical oxygen demand is one measure of the effects of industrial waste discharges. Hardness and iron content are in the range which requires treatment (removal) for some water uses.

During concurrent periods of low stream flow and maximum temperature, the present waste loads may be expected to cause major water quality problems because of dissolved oxygen concentrations below the standards of 5.0 mg/l on the Winnebago River (Lime Creek) at Mason City, and the Cedar River at Waterloo and Cedar Rapids. Also, the projected 1980 waste loads may be expected to cause water quality problems on the Winnebago River (Lime Creek) at Forest City, Iowa. Minor and local water quality problem areas that are difficult to locate and document exist or may be expected to occur in the future. Examples are inadequate sewerage systems and waste treatment in small communities or in expanding urban areas in large communities, overloaded treatment plants, spills of toxic materials from industrial establishments, and problems with treatment plant operation.

Fox River

The surface water quality of the Fox River reflects the predominantly agricultural nature and high sediment yields of the basin. There is little industrialization or large population centers along the river.

Surface water in the Fox River is classified as a calcium bicarbonate type on the basis of the predominant ions in the water, but sulfate and magnesium are a significant part of the total ionic composition. These four ions together constitute about 90 per cent of the total ions in the water. The river has a high mineral content. The dissolved solids contents averaged 280 ppm. The city of Bloomfield obtains its water supply from the Fox River. The water is generally of good quality and is also used for livestock watering and irrigation. Surface waters for irrigation purposes are classified as medium salinity, low sodium water, suitable for irrigation of plants with moderate salt tolerance.

Animal waste and land runoff could create a water quality problem. The problems created by animal wastes become severe where the animals are concentrated in feedlots along streams. The effect upon water quality in the stream can be just as detrimental as that created by municipal or industrial waste discharges.

The usage of fertilizers in the Fox River basin is quite extensive. Although the amount of fertilizers and animal wastes reaching the streams from runoff is not known, it is believed that the quantities are of sufficient magnitude to have a detrimental affect on water quality. Land runoff studies have shown that 10 to 25 per cent of the fertilizers applied to the land have been lost through drainage.

Existing Water Uses

The Water Quality Criteria adopted by the Iowa Water Pollution Control Commission list the following present uses: municipal water supply, industrial water supply, livestock watering, fish propagation, recreation, wildlife habitat and irrigation. Other existing uses are: electrical generation, cooling, hydropower, mining, and commercial navigation. Some of these uses could degrade existing high quality waters.

There are 39 communities in Iowa that utilize surface waters for domestic supplies. Six utilize interstate waters in the Mississippi basin, and total average daily use is 28.2 MGD (million gallons per day).

The industrial water supply withdrawals from interstate streams have not been specifically identified. However, the use in the counties adjacent to the Mississippi River has been estimated at 156 MGD of which most is withdrawn from the river.

The mineral industry in Eastern Iowa at present utilizes water for processing of sand and gravel. Annual average use is 8 MGD.

Fossil fuel steam electric generating plants in proximity to the interstate streams have a rated capacity of 2,030 megawatts. Nearly one half, 950 mw, is adjacent to the Mississippi River. Average use rates of 550 gpm per mw used by the FPC for planning indicate a present need for 1,100,000 gpm or 1,600 MGD during peak seasons. This is based on an 18°F rise in temperature. Cooling towers and ponds reduce the total requirements. The Duane Arnold nuclear fueled plant with 550 mw is being planned near Cedar Rapids.

There are several small hydroelectric plants on the Iowa streams having 7 mw capacity. The Keokuk plant on the Mississippi River has a rated capacity of 125 mw. This plant utilizes the available flow in the river and has a gross head of 36 feet. The dam at Davenport has two small plants on the Illinois side.

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The Mississippi River has been developed to accommodate commercial navigation with a draft of 9 feet. Eleven impoundments from Lock and Dam No. 9 through 19 provide the depths even during low flow conditions. In 1964 the Mississippi River system conveyed 45.7 million tons of cargo.

The 312 miles of pools in the Mississippi River provide the potentially best fishery resource in the State of Iowa. This not only provides sport fisheries in the backwater areas, but allows significant commercial fisheries. The Iowa commercial fishery landed an average of 2,623,000 pounds with a value of $226,000 or 22 per cent of the total Upper Mississippi River catch of 11,611,000 pounds and $1,068,000 in the 1961-65 period. Principal species are buffalo, carp, catfish and sheepshead. Mussel harvesting for shell buttons has declined but harvesting is now showing resurgence due to the Japanese market for the mussel shells. The Upper Mississippi River Type I study estimates that the 1960 usage of Iowa streams was 6,210,000 angler days. No breakdown is available for interstate streams. The Corps of Engineers multipurpose reservoirs are beginning to augment the available resources. Most of the fisheries are warm water, but selected segments of tributaries in the Northeastern portion can support cold water species.

Wildlife uses of water are generally insignificant except for the migratory waterfowl usage of the Mississippi flyway.

Water based outdoor recreation has become a rapidly increasing aspect of modern living. This includes swimming, boating, water skiing, canoeing, and the other related activities such as sight-seeing, hiking, camping and picnicking. Twenty-four of the 36 stream recreational sites designated by the State are on interstate streams.

Recreational usage of Eastern Iowa waterways is more intense along the Mississippi Corridor due to favorable natural terrain. The 1964 demand for water related activities was 72.6 million recreation days. Of this 43.0 million recreation days were satisfied. The Red Rock and Saylorville Reservoirs when completed will materially reduce the unmet demand. The development of the Mississippi Corridor under the Great River Road Program is the most significant program in this area. The remaining waters and surrounding lands have been developed by urbanization and agriculture so that the quality of the recreation is less than satisfactory. Sediment, animal wastes, industrial and domestic effluents and low discharge characteristics of the streams are reasons for this.

Development of the interstate streams for rural domestic livestock watering and irrigation is at present widely dispersed throughout the basin. The permit system for surface diversions allows use only when the "established average minimum flow is preserved."

Standards of Related States

One of the guidelines for establishing water quality standards for interstate waters set forth by the Department of the Interior was that State standards were to be reviewed in terms of their consistency and comparability with those for affected waters of downstream or adjacent States (see Appendix). This policy has been followed in the review of all standards approved up to the present and was followed in the review of the Iowa water quality standards. The results of this review are reflected in those items which were excepted from approval by the Secretary of the Interior. The following paragraphs summarize certain criteria and requirements from the standards of States adjacent to or downstream of Iowa.

Treatment

Every State which borders on the Mississippi River, with the exception of Iowa, has adopted as part of its standards a requirement for secondary treatment or its equivalent for wastes discharged into the Mississippi River. The language used by these States varies somewhat, but all essentially state this requirement. The final compliance dates for implementation of minimum treatment varies with each State as shown in Table II.

TABLE II

FINAL COMPLIANCE DATES FOR IMPLEMENTATION OF SECONDARY OR EQUIVALENT TREATMENT FOR STATES ON THE MISSISSIPPI RIVER

Minnesota	June 30, 1972
Wisconsin	October 31, 1970
Missouri	December 31, 1982
Kentucky	December 31, 1977
Tennessee	December 31, 1972
Arkansas	October 31, 1972
Mississippi	December 31, 1972
Louisiana	December 31, 1972

The Illinois standards for the Mississippi River provide for a minimum of secondary treatment but do not contain a final compliance date and have not been approved by the Secretary of the Interior. The December 1982 date for Missouri is an outside date for final compliance and an earlier compliance date is expected as a result of on-going stream surveys.

Disinfection

All of the States adjoining Iowa in the Mississippi River basin have established acceptable bacterial criteria for interstate waters. Minnesota and Missouri have set limits on the bacterial concentrations for all interstate waters and all uses in the Mississippi River basin. The criteria in Missouri are not applicable when streams are affected by storm water runoff. Illinois and Wisconsin have set criteria for interstate waters used for public water supply and for recreation. Illinois has limited the application of the criteria for recreational waters to the recreation season defined as April through October. In addition to establishing bacterial criteria, Illinois, Minnesota and Wisconsin have established treatment requirements with regard to disinfection of effluents. Illinois requires disinfection where a significant bacterial increase can be identified with a controllable waste discharge supplemented by an effluent standard with regard to discharges into recreational waters. Minnesota standards require the effective disinfection of any discharges, including combined flows of sewage and storm water, where necessary to protect the specified uses of the interstate waters. Wisconsin standards provide for year-around disinfection of sewage treatment plant effluents where public water supplies are involved and where necessary to protect public health in addition to effluent disinfection for recreational waters during the recreation season.

Temperature

Within the Mississippi River basin, Iowa shares common boundaries with Minnesota and Missouri where waters other than the Mississippi River flow between the States. Minnesota has established temperature criteria on these waters which limits the temperature increase to 5°F above ambient temperature except in Class A fishery waters where no increase is permitted or to a maximum temperature as shown in Table 12.

TABLE 12

MINNESOTA MAXIMUM TEMPERATURES °F

Class of Water	Ja	F	Mr	Ap	My	Jn	Jl	Ag	Se	Oc	N	D
2A Fisheries & Recreation	No material increase above natural											
3A Industrial Consumption	35	35	40	50	60	70	75	75	70	60	50	40
2B Fisheries & Recreation	37	37	43	55	67	80	86	86	80	67	55	43
2C Fisheries & Recreation	45	45	51	63	75	87	90	90	87	75	63	51

Missouri standards state that effluents shall not elevate or depress the average cross sectional temperature of the stream more than 5°F, and the stream temperature shall not exceed 90°F. Missouri has set a maximum temperature of 93°F in the Des Moines River.

Wisconsin and Illinois do not share waters with Iowa except for the Mississippi River; however, the interior waters of these States are similar in nature to those of Iowa. The Wisconsin standards specify for cold water fisheries that temperature not exceed 84°F and for warm water fisheries that it not exceed 89°F. Also, there shall be no change from background of more than 5°F in both types of waters. The temperature criterion for aquatic life in Illinois is a maximum temperature of 90°F with no cumulative change greater than 5°F from natural water temperature.

Phenols

Minnesota requires that the phenol content of waters used for public water supplies not exceed 0.001 mg/l. This standard follows that of the U. S. Public Health Service and is one-twentieth the level of the present Iowa standard.

Radioactivity

The States adjacent to Iowa, namely, Minnesota, Wisconsin, Illinois and Missouri, require that waters used for a public water supply meet the radioactivity standards set by the U. S. Public Health Service in their 1962 drinking water standards promulgation. The USPHS requirement specifies limits on radium-226 and strontium-90 which are presently absent from the Iowa standard.

Protection of High Quality Waters

The States of Illinois, Missouri and Wisconsin have had approved by the Secretary of the Interior statements of policy regarding the protection of present high quality waters. The text of their statements follow:

(Illinois) Waters whose existing quality is better than the established standards as of the date which such standards become effective will be maintained in their present high quality within the powers granted by the Illinois Water Pollution Control Statutes. Such waters will not be lowered in quality unless and until it has been affirmatively demonstrated to the Federal Water Pollution Control Administration that such change is justifiable as a result of necessary economic or social development and will not interfere with or become injurious to, any appropriate beneficial uses made of, or presently possible in such waters.

(Missouri) It is recognized that certain of the waters under consideration possess an existing quality which is better than the standards established herein. The quality of these waters will be maintained unless and until it has been affirmatively demonstrated through public hearings that other uses and different standards are justifiable as a result of necessary economic or social development. It will be required that the highest and best technology be employed to maintain the high quality of the waters. Additional data and increased monitoring in cooperation with the Federal Government and other states, will permit the improvement of these standards. The interest of the Federal Government in interstate waters is recognized and this interest will be protected.

(Wisconsin) Regardless of the water quality standards and water use, untreated or inadequately treated wastes may not impair a designated use nor may standards be interpreted to permit a lower quality within a water sector than that now existing or required by outstanding orders.

Part IV

FUTURE GROWTH

Economy

The eastern portion or Iowa which drains to the Mississippi River is expected to increase its 1960 total population of approximately 1.9 million to almost 2.5 million (32 per cent) by 1980. The Cedar River basin area is likely to show a more rapid growth rate than either of the other areas.

The non-farm population of the study area (about 1.4 million in 1960) is more closely related to municipal water demands and waste flows and loads and is projected to grow more rapidly than the total population - about 53 per cent by 1980, with that of the Cedar River basin area again showing the more rapid rate of increase.

By 1980, total manufacturing in the area is projected to double from its 1960 level. The food and chemical industries are expected to show even more rapid growth.

Des Moines River Basin

The total population of the Des Moines River basin area is expected to increase about 32 per cent over its 1960 base by 1980 - from 845,000 to 1,112,000. Farm population is expected to decline. Polk County, which comprises the Des Moines Standard Metropolitan Statistical Area (SMSA) will account for over half of the growth and have the greatest rate of increase - about 50 per cent by 1980. About 97 per cent of the population of Polk County is non-farm. Most of the other counties will have some increases in population, but at a slower rate of growth. Total manufacturing activity is expected to more than double by 1980 and to continue at about the same growth rate in later decades. Rates of growth are likely to vary among the industries with the food industry more than doubling its 1960 base by 1980; parts of the chemical industry may even exceed this rate of growth. The number of beef cattle and calves, while not expected to change substantially by 1980 is likely to increase in later decades; the number of hogs and pigs is expected to increase significantly by 1980 as well as in later periods.

Cedar River Basin

The total population of the Cedar River basin area is expected to increase about 40 per cent over its 1960 base by 1980 - from 548,000 to 762,000. Within the Cedar River basin area, Black Hawk County (Waterloo SMSA) and Linn County (Cedar Rapids SMSA) are expected to have the greatest total and percentage increase in population by 1980, with Black Hawk County increasing 67 per cent and Linn County increasing 61 per cent. Other smaller counties, such as Cerro Gordo and Muscatine will also have substantial

percentage increases. Total manufacturing activity is expected to at least double its 1960 base by 1980 and to continue this rapid growth rate in future decades, with the greatest rates of growth in selected food and chemical activities. The number of beef cattle and calves is not likely to change substantially by 1980, but is expected to increase in both near future and later decades.

Other River Basins

The total population of the Turkey, Maquoketa, Wapsipinicon and Upper Iowa River basins area is expected to increase about 30 per cent over its 1960 base by the year 1980 from 461,000 to 598,000. Within this area Dubuque County (Dubuque SMSA), Scott County (Iowa part of the Davenport-Rock Island-Moline SMSA), and Clinton County are likely to have the greatest total and percentage population increases. Total manufacturing activity is projected to more than double its 1960 base by 1980, with comparable growth rates in later decades - some of the food and chemical industries may increase more rapidly. The number of beef cattle and calves is not likely to change substantially in near future decades; the number of hogs and pigs is likely to increase in both the near and long-range future decades.

Potential Use of Waters

The growth in population and economy will result in increased utilization of the waters in the State of Iowa. This use will concentrate along the major rivers where the growth can be more readily accommodated.

Growth in water uses, both domestic and industrial, between 1960 and 1980 will be about 75 per cent. Total uses will increase from 431.9 MGD to 771.1 MGD. The larger streams, which except for the Skunk and upstream part of the Iowa River, are interstate, will be utilized for much of this increase.

By 1980 the eastern portion of Iowa and small parts of Illinois and Minnesota (Power Supply Area 17 as defined by the Federal Power Commission), will have a need for 6,330 mw of installed capacity. This is a 180 per cent increase from the 1965 base. Generation and demands for cooling water will be in proportion to this increase. Flow through uses will approximate 5,000 MGD unless evaporative cooling is utilized. The Mississippi River will provide most of the withdrawal.

The Corps of Engineers does not anticipate projects on the tributaries of the Mississippi to increase commercial navigation. The medium estimate of 1980 tonnage on the Mississippi River is 66 million tons. To accommodate this growth and the even larger 50 year estimates of 147 million tons, the Corps of Engineers with cooperation from other agencies is evaluating the development of a 12 foot channel. This development can be accomplished by raising impoundments, dredging or a combination. The method selected will have significant effects on fishery, wildlife and recreational uses.

The Bureau of Commercial Fisheries does not forecast a significant change in the production of marketable fish. Enhanced water quality would increase production and insure an untainted product.

The sport fishery demand in eastern Iowa will increase to 7.5 million angler days by 1980 of which 10 per cent will be unsatisfied. The proposed 12 foot channel could affect the sport fish supply in the Mississippi River. At present, suitable access sites and the species availability restrict usage. Water quality improvement will allow more desirable species to become established. Tributary streams must also be protected to provide suitable habitat for the desirable species. The quality in the large reservoirs should be given study to allow maximum fishery utilization. Algal growth and stratification control are major factors to consider.

Water related recreation demand will increase to 115.7 million recreation days by 1980 in eastern Iowa, the continuation of present programs will result in the unsatisfied demand of 49.1 million recreation days. An action program is therefore needed to provide more and better facilities. Measures to prevent and abate water pollution at its source are stressed as critical needs in the Upper Mississippi Report. The Bureau of Outdoor Recreation is presently involved in the following studies to provide more facilities and opportunities for outdoor recreation: the Upper Mississippi River Valley National Recreational Area Study; the Upper Iowa Scenic or Wild River Study; the National Recreation Area Study for Northwest Illinois and Eastern Iowa; and the Twelve Foot Channel Navigation Project. The concentration of effort in this area has resulted since the northeastern Iowa area is the most esthetically pleasing area of the state for outdoor recreation.

GPO 812-187-5

PART V

QUALITY STANDARDS NECESSARY TO SUPPORT EXISTING AND FUTURE WATER USES

Treatment Requirements

It is the purpose of the Water Quality Act of 1965 to enhance the quality of our water resources, and in so doing, respond to the public's mandate and expectations for bringing water pollution under control by improving the existing quality of water for future needs and uses. The Water Quality Act of 1965 in providing for the establishment of water quality standards was interpreted by the U. S. Department of the Interior in the "Guidelines for Establishment of Water Quality Standards for Interstate Waters" of May 1966 to mean that "The water quality standards proposed by a State should provide for: a) Potential and future water uses as well as the present intended use and uses; b) The upgrading and enhancement of water quality and the use or uses of streams or portions thereof that are presently affected by pollution; c) The maintenance and protection of quality and use or uses of waters now of a high quality or of a quality suitable for present and potential future uses."

Interior Guidelines reflect Congressional intent and purpose as contained in the legislative history of the Water Quality Act of 1965: ". . . water quality standards should be applied on the basis of the water quality requirements of present and future uses of a stream or section of stream, after due consideration of all factors and variables involved." "Economic, health, esthetic, and conservation values which contribute to the social and economic welfare of an area must be taken into account in determining the most appropriate use or uses of a stream. There ought to be a constant effort to improve the quality of the water supply, it being recognized that the improvement of the quality of water makes it available for more uses." ". . . water quality standards are not designed to 'lock in' present uses of water or to exclude other uses, not now possible. The standards are not a device to insure the lowest common denominator of water quality but to enhance the quality and productivity of our water resources."

Treatment criteria established for the Mississippi River must provide for upgrading the degree of treatment to be consistent with a policy of preventing water pollution problems rather than the abatement of such problems after they occur. The Water Quality Act gives direction for the control of water pollution and emphasizes the need for enhancement of water resources. The Federal legislation fully intended for water pollution control programs to make advances by improving and restoring the water resources of low quality and at the same time protecting high quality waters. Secondary treatment for municipal waste sources and an equivalent level of waste removal for industrial discharges is the least degree of treatment acceptable which would effectively support the intent of such programs. It is the responsibility at the Federal level to be certain that the plans developed by the State of Iowa are effective and reasonable in conformance with the purpose

of the Water Quality Act, and in conformance with the standards established throughout the river basin. A uniform approach is necessary to achieve basin-wide water quality goals.

The Iowa water pollution control plan for Fiscal Year 1969 lists secondary treatment as the type of water pollution control facility required at three locations on the Mississippi River. The one year municipal listing dated July 1, 1968 recognizes the need for secondary treatment at New Albin and Lansing, and the five year list of municipal construction needs covering a period from July 1, 1968 to June 30, 1973 includes Montrose, as a municipality requiring secondary treatment. The City of Dubuque, recognizing on its own the need for additional treatment higher than primary, is presently installing secondary treatment. Construction of the Dubuque secondary plant is scheduled for completion in October 1970. A treatment requirement at the secondary level for all the remaining waste sources of the State of Iowa on the Mississippi River will complete the logical and compatible requirement for water quality standards with other bordering States sharing the responsibility of protecting and improving the river water quality.

Disinfection Requirements

Pathogenic agents are found in the feces of humans and animals acutely ill with an intestinal or related infection and in the feces of apparently healthy carriers of the organisms. The collection and treatment of fecal material to reduce its organic, oxygen demanding characteristics does not preclude the survival of disease causing organisms and their entry into a watercourse. Water-borne infectious diseases may be caused by bacteria, protozoa, worms, viruses and fungi. Human feces are the primary source of pathogenic enteric organisms; and the enteric, water-borne, bacterial infections include typhoid fever, paratyphoid fever, bacillary dysentary and cholera.

Human wastes and many animal wastes must be presumed to contain causative agents of communicable disease, whether or not each specific type is isolated, identified, and counted. These agents are indicated by the presence of indicator organisms. It may be assumed that a health hazard is present whenever appreciable concentrations of fecal indicators are encountered.

It is significant that many pathogenic agents can survive in the water environment for long periods of time, becoming dormant under certain conditions only to have their virulence restored when conditions change, as from cold to warmer weather. Thus, inadequately treated wastes may remain a health hazard for many miles downstream. Pathogenic agents in these wastes may find their way into public water supplies or be ingested through body contact recreation. Wherever people contact these waters, the hazard remains: to children swimming or playing along the shore, to canoeists, waterskiers and fishermen, or to any who make use of the infested waters. Some organisms may also reach man through fish and their aquatic life chain, as well as through warm-blooded animals. Studies have demonstrated that

once fish are exposed to high bacteria levels they become carriers for periods of two weeks or more.

These waters should be available and safe for all uses, and pathogenic agents from both human and animal origin can be controlled. The effectiveness of disinfection and adequate treatment in reducing pathogenic agents has been proven. Animal sources may be more difficult to control; but as a significant first step, pathogenic agents of human origin can be measurably reduced by continuous disinfection of all municipal wastes and industrial wastes which may contain pathogenic organisms.

Temperature Requirements

The most critical water use affected by temperature is the protection of aquatic life. Other uses such as swimming and other body contact recreation, public water supply and industrial water supply are also affected.

The effect of unnatural changes of water temperature on the ecology of the river can be devastating. This is true at any time of an organism's life cycle, and thus any time of the year. The relationship between temperature and aquatic life is one that has been well studied. Table 13 gives the maximum temperature associated with the survival of various fish. Many of the organisms which serve as food for the larger fish have equal or more critical temperature requirements. Tables 8 and 9 list the normally found temperature variation for several river sectors. These temperatures are presently affected by waste heat sources. Maximum temperatures have only occasionally exceeded 90°F even with present waste heat inputs, and normally do not exceed 85°F.

Many of the interstate waters of Iowa are used for fishing. The fish and other aquatic life presently found in these waters are species or varieties which have become established because of changed ecological conditions, such as temperature and various other factors, and are not necessarily indisenous to the area. The interrelationships between aquatic life forms, seasonal daylight changes and water temperature are so intimate that even a small change in temperature from the normal may have far-reaching effects.

In an artificially warmed stream, an insect nymph which would normally be part of the food chain might emerge for its mating flight too early in the spring and be immobilized by the air temperature. Similarly, a fish might hatch too early in the spring and find an inadequate amount of its natural food organisms because the food chain depends ultimately on plants whose abundance in turn, is a function of the period of daylight and temperature. Although aquatic life can endure the extremes of temperature at appropriate seasons; it must be cooled gradually in the fall if it is to become acclimatized to the cold water of winter and warmed gradually in the spring if it is to withstand summer heat. Further, an organism might be able to endure a high temperature for a few hours, but it could not do so for a period of days. Having the water change gradually with the season is very important since an increasing or decreasing temperature often serves

TABLE 13

PROVISIONAL MAXIMUM TEMPERATURES RECOMMENDED AS COMPATIBLE WITH THE WELL-BEING OF VARIOUS SPECIES OF FISH AND THEIR ASSOCIATED BIOTA

93 F:	Growth of catfish, gar, white or yellow bass, spotted bass, buffalo, carpsucker, threadfin shad, and gizzard shad.
90 F:	Growth of largemouth bass, drum, bluegill, and crappie.
84 F:	Growth of pike, perch, walleye, smallmouth bass, and sauger.
80 F:	Spawning and egg development of catfish, buffalo, threadfin shad, and gizzard shad.
75 F:	Spawning and egg development of largemouth bass, white, yellow, and spotted bass.
68 F:	Growth or migration routes of salmonids and for egg development of perch and smallmouth bass.
55 F:	Spawning and egg development of salmon and trout (other than lake trout).
48 F:	Spawning and egg development of lake trout, walleye, northern pike, sauger, and Atlantic salmon.

Source: Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, April 1, 1968, P. 43.

as the trigger for spawning, metamorphosis, and migration. The effect of thermal shock can be more harmful than continued exposure to a higher temperature.

An increase in water temperature lowers the desirability of a water for domestic and industrial water supply. Also, as the water temperature increases, the predominant species of algae are changed from diatoms, to green, and then to blue-green. The blue-green algae are often associated with taste and odor problems and slime growths.

Phenol Requirements

Phenols are organic chemicals which are not appreciably removed in conventional water treatment plants. For waters which are to be used for public water supplies, the recommendation of the U. S. Public Health Service is that concentrations above 0.001 mg/l not be permitted. The present Iowa standards for phenols is twenty times this value (0.020 mg/l).

Radioactivity Requirements

Water treatment plants remove little radioactive pollution from raw water supplies. The Department of the Interior is interested in upgrading radiological criteria to conform to the latest recommendations of Federal agencies. Iowa concurs with this objective.

Protection of High Quality Waters

The Federal Water Pollution Control Act, as amended, in its declaration of policy, states, "The purpose of this Act is to enhance the quality and value of our water resources and to establish a national policy for the prevention, control and abatement of water pollution."

In order that existing high quality water be retained at present quality levels, each State has been asked to adopt a statement of policy. The statement should contain the following four points:

1. Commitment by the State to the preservation of high quality waters.

2. The best practicable degree of treatment for wastes discharged into high quality waters.

3. Degradation only where necessary economic or social development is demonstrated.

4. Some procedural commitment so that the Department of the Interior can be assured that the degree of treatment is adequate and degradation is "necessary."

On March 6, 1969, the Iowa Water Pollution Control Commission agreed to a motion supporting statements as adopted by some western States and approved by the Department of the Interior concerning the protection of waters whose quality may exceed that of established standards.

Typical language is as follows:

> Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at high quality; provided that the State has the power to authorize any project or development, which would constitute a new souce of pollution or an increased source of pollution to high quality water, when it has been affirmatively demonstrated that a change is justifiable to provide necessary economic or social development; provided further that the necessary degree of waste treatment to maintain high quality water will be required where physically and economically feasible. Present and anticipated use of such waters will not be precluded under the conditions aforesaid. In implementing this policy the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act, as amended.

Formal adoption of a similar statement as part of enforceable standards by Iowa is expected.

PART VI

RECOMMENDATIONS

The following recommendations are made for adoption as water quality standards for the State of Iowa.

Treatment

The treatment requirement and implementation plan for waste dischargers to the Mississippi River are recommended as follows:

> All municipal wastes shall receive secondary treatment. All industrial wastes shall receive comparable treatment or control.
>
> Preliminary engineering reports to accomplish the above shall be available by Dec. 31, 1969. Final plans and specifications shall be completed by Dec. 31, 1970. Financing arrangements shall be completed by April 1, 1971. Construction shall start no later than July 1, 1971. The required municipal and industrial waste treatment facilities shall be constructed and in operation no later than Dec. 31, 1972.

Disinfection

The disinfection requirements for controllable waste discharges which may be sources of bacterial pollution are recommended as follows:

> Continuous disinfection is to be provided throuthout the year for all municipal waste treatment plant effluents, including the effluents from waste stabilization ponds, and for all industrial wastes containing pathogenic agents.
>
> Disinfection facilities shall be placed in operation for all municipalities no later than Dec. 31, 1970. Industrial wastes containing pathogenic agents shall be disinfected year-round also, beginning no later than Dec. 31, 1970.

Temperature

The temperature requirements for the interstate waters of Iowa flowing to the Mississippi River are recommended as follows:

> At no time shall the addition of heat be authorized which will raise water temperature more than 5°F; but in any event the addition of heat shall not raise water temperatures above a maximum tailored for each individual lake or stream and necessary to protect the production of locally occurring desirable fish populations and their associated biota.

Phenols

The maximum levels for phenols in the interstate waters of Iowa are recommended as follows:

The concentration of phenols shall not exceed 0.001 mg/l.

Radioactivity

The following are recommended expressions of adequate radiological limits:

1. Radioactive materials of other than natural origin shall not be permitted to exceed the standards for drinking water as promulgated by the U. S. Public Health Service (PHS Publication 956, 1962) or 1/30 (168 hr. value) of of the values for radioactivity specified in National Bureau of Standards Handbook 69.

2.(a) The annual average concentration (dissolved) of a specific radionuclide, excluding radium-226 and strontium-90, should not exceed 1/30 of the appropriate maximum permissible concentration for the 168-hour week given in the reports of the International Commission on Radiological Protection and the National Committee on Radiation Protection. Limiting concentrations of radium-226 and strontium-90 are those set forth in the USPHS Drinking Water Standards: 3 and 10 pc/l, respectively.

2.(b) It may be necessary to limit the concentration of radioactivity in the water to a value substantially less than that permitted by the criteria of paragraph (a) if it appears likely that the average daily intake from air, food, and water of an exposed population group would otherwise exceed the permissible limit.

2.(c) Because any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in natural waters should be maintained at the lowest practicable level.

Protection of High Quality Waters

It is recommended that a non-degradation provision be incorporated as a necessary part of water quality standards.

GPO 812-187-4

Part VII

APPENDIX

Notice of Standard Setting Conference

UNITED STATES

Department of the Interior
Federal Water Pollution Control Administration
Washington

Notice of Standard Setting
Conference: Interstate Waters of
the State of

IOWA

The waters of the Mississippi River, Missouri River, Fox River, Des Moines River, East Fork of the Des Moines River, West Fork of the Des Moines River, Iowa River, Cedar River, Shellrock River, Winnebago River, Wapsipinicon River, Upper Iowa River, Chariton River, Middle Fork Medicine River, Weldon River, Little River, Thompson River, East Fork of the Big River, Grand River, Platte River, East Fork of the 102 River, Middle Fork of the 102 River, Nodaway River, West Tarkio River, Tarkio River, Nishnabotna River, Little Sioux River, Big Sioux River, Rock River, and Kanaranzi Ditch, subject to the jurisdiction of the State of Iowa, are interstate waters.

The water quality standards established by the State of Iowa in accordance with section 10(c)(1) of the Federal Water Pollution Control Act (33 U.S.C. 466g(c)(1)) to be applicable to these waters are determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water, and the purposes of the Federal Water Pollution Control Act, as provided by section 10(c)(3) of that Act, with particular reference to:

1. The treatment requirements and implementation plan for waste discharges to the Mississippi and Missouri Rivers;

2. The requirements for disinfection of controllable waste discharges which may be sources of bacteriological pollution;

3. The temperature criteria for the interstate waters of the State other than the Mississippi and Missouri Rivers.

Therefore, in accordance with the provisions of section 10(c)(2) of the Federal Water Pollution Control Act (33 U.S.C. 466g(c)(2)), I hereby call a conference to consider the establishment of water quality standards applicable to the above interstate waters subject to the jurisdiction of the State of Iowa.

The conference will convene on April 8, 1969, at 9:30 a.m. at the Blackhawk Hotel, 3d and Perry Streets, Davenport, Iowa, to consider the appropriate water quality standards for the interstate waters of the Mississippi River Basin and on April 15, 1969, at 9:30 a.m. at Mercy Hospital Auditorium, 420 East Washington Street, Council Bluffs, Iowa, to consider the appropriate water quality standards for the interstate waters of the Missouri River Basin. I have designated Mr. Murray Stein, U. S. Department of the Interior, as Chairman of the conference.

Parties to the conference will be representatives of Federal departments and agencies, interstate agencies, States, municipalities, and industries who are contributing to, affected by, or have an interest in the water quality standards for the waters to be covered by the conference and who register their intent to be parties at the conference sessions, and such other persons whom the Chairman, upon application and good cause shown, admits as parties to the conference.

/s/ Walter J. Hickel
Secretary of the Interior

DATED: March 5, 1969

Guidelines for Establishing Water Quality Standards for Interstate Waters

The Water Quality Act of 1965 amended the Federal Water Pollution Control Act to provide for establishment of water quality standards for interstate waters. In the absence of State action, such standards will be adopted by the Secretary of the Interior under procedures set forth in the Act.

Standards adopted by a State will become the standards applicable if:

1. The Governor or water pollution control agency filed by October 2, 1966, a letter of intent that the State, after public hearings, will, before June 30, 1967, adopt (a) water quality criteria applicable to interstate waters or portions thereof within the State, and (b) a plan for the implementation and enforcement of the criteria;* and,

2. The State subsequently adopts such criteria and plan; and,

3. The Secretary determines that the State criteria and plan are consistent with the purposes of the Act, i.e., "....to enhance the quality and value of our water resources and to establish a national policy for the prevention, control, and abatement of water pollution."

It is the position and purpose of the Federal Water Pollution Control Administration to encourage and support the States in establishing their own standards. The guidelines that follow are presented to assist the States in the development of the required water quality criteria and the plan for the implementation and enforcement thereof, and to delineate factors which will be considered in the Secretary's determination of whether the criteria and plan are consistent with the purposes of the Act.

Guidelines in the Act and its Legislative History

First consideration should be given to the substantive guidelines on Congressional intent and purpose in establishing the water quality standards requirement that are contained in the Federal Water Pollution Control Act, as amended by the Water Quality Act of 1965, and in its legislative history:

1. "Standards of quality established pursuant to this subsection shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this Act. In establishing such standards

*All States submitted such letters

the Secretary, the Hearing Board, or the appropriate State authority shall take into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, agricultural, industrial, and other legitimate uses." (Section 10(c)(3) of the Act.)

2. "The discharge of matter into such interstate waters or portions thereof, which reduces the quality of such waters below the water quality standards established under this subsection (whether the matter causing or contributing to such reduction is discharged directly into such waters or reaches such waters after discharge into tributaries of such waters), is subject to abatement in accordance with the provisions of ...." the Act. (From Section 10(c)(5) of the Act).

3. "Economic, health, esthetic, and conservation values which contribute to the social and economical welfare of an area must be taken into account in determining the most appropriate use or uses of a stream. There ought to be a constant effort to improve the quality of the water supply, it being recognized that the improvement of the quality of water makes it available for more uses." (Senate Report No. 10 on the Federal Water Pollution Control Amendments of 1965, 89th Congress, 1st Session).

4. "Water quality standards would provide an engineering base for design of treatment works by municipalities and industries. Such standards would enable municipalities and industries to develop realistic plans for new plants or expanded facilities, without uncertainties about waste disposal requirements on interstate waters." (Senate Report No. 10, as above).

5. "Water quality standards are not designed for use primarily as an enforcement device; they are intended to provide the Secretary and State and local agencies with additional tools for objective and clear public policy statements on the use or uses to which specific segments of interstate waters may be put. Their principal objective is the orderly development and improvement of our water resources without the necessity of adversary proceedings which inevitably develop in enforcement cases." (Senate Report No. 10, as above).

6. "The committee must reemphasize its intent that water quality standards are not designed to 'lock in' present uses of water or to exclude other uses, not now possible. The standards are not a device to insure the lowest common denominator of water quality but to enhance the quality and productivity of our water resources." (Senate Report No. 10, as above).

7. "The committee intends that water quality standards should be applied on the basis of the water quality requirements of present and future uses of a stream or section of stream, after due consideration of all factors and variables involved." (Senate Report No. 10, as above).

Policy Guidelines

No one has the right to pollute. As President Johnson expressed it when he signed into law the Water Quality Act of 1965, "No one has a right to use America's rivers and America's waterways that belong to all the people as a sewer. The banks of a river may belong to one man or one industry or one state, but the waters which flow between those banks should belong to all the people."

In support of the President's position, the specific provisions of the Water Quality Act of 1965, and expressions of policy by the Congress in enacting that legislation, the following additional policy guidelines are set forth:

1. Water quality standards should be designed to "enhance the quality of water." If it is impossible to provide for prompt improvement in water quality at the time initial standards are set, the standards should be designed to prevent any increase in pollution. In no case will standards providing for less than existing water quality be acceptable.

2. No standards of water quality will be approved which provide for the use of any stream or portion thereof for the sole or principal purpose of transporting wastes.

3. Water quality criteria should be applied to the stream or other receiving water or portions thereof. The criteria should identify the water uses to be protected and establish limits on pollutants or effects of pollution necessary to provide for such uses. Numerical values should be stated for such quality characteristics where such values are available and applicable. Where appropriate, biological bioassay parameters may be used. In the absence of appropriate numerical values or biological parameters, criteria should consist of verbal descriptions in sufficient detail as to show clearly the quality of water intended (e.g., "substantially free from oil").

4. The measure of time period and limiting values which will govern for purposes of the criteria should be defined (e.g., annual arithmetric mean concentration, single daily maximum concentration). Where appropriate, the specified recurrence and duration of the accepted design streamflow should be defined (e.g., 25-year recurrence of minimum lowflow of 10-day duration).

5. Water quality criteria should be accompanied by a description of present water quality and uses, together with uses expected in the future and the water quality required to make those uses possible. The water quality standards proposed by a State should provide for:

(a) Potential and future water uses as well as the present intended use and uses;

(b) The upgrading and enhancement of water quality and the use or uses of streams or portions thereof that are presently affected by pollution;

(c) The maintenance and protection of quality and use or uses of waters now of a high quality or of a quality suitable for present and potential future uses.

6. The plan for implementing and enforcing the water quality criteria should be submitted in sufficient detail to describe the nature of the actions to be taken to acheive compliance, a time schedule for such compliance, the controls and surveillance for measuring compliance, and the enforcement authority and measures for ensuring compliance. It is recognized that there are a number of ways that the water quality standards can be effectively implemented and enforced by the States; achievement of the purposes of the Act, rather than the methods by which this is done, is paramount.

7. The plan should include consideration of all relevant pollutional sources, such as municipal and industrial wastes, cooling water discharges, irrigation return flows, and combined sewer overflows.

8. No standard will be approved which allows any wastes amenable to treatment or control to be discharged into any interstate water without treatment or control regardless of the water quality criteria and water use or uses adopted. Further, no standard will be approved which does not require all wastes, prior to discharge into any interstate water, to receive the best practicable treatment or control unless it can be demonstrated that a lesser degree of treatment or control will provide for water quality enhancement commensurate with proposed present and future water uses.

9. Public hearings are required to be held by States establishing standards in accordance with the provisions of the Act.

A summary of each public hearing, accompanied by certification as to notice and conduct of such public hearing in conformity with procedures provided therefor, should be provided the Secretary. The summary should adequately advise him of:

(a) The waters which were the subject of the public hearing;

(b) The interests and interest groups represented, including those in downstream or adjacent States which would be affected by the standards;

(c) The views expressed on water quality and water uses by the various interests and interest groups;

(d) Statistical data, reports and other information submitted in support of statements, views and positions expressed at

the hearing, including those provided by the State or States holding the hearing.

When necessary to the Secretary's determination that the State criteria and plan are consistent with the purposes of the Act, a full transcript of the hearing and supporting data will be requested.

In the review of the hearing record to determine whether the State criteria and plan are consistent with the purposes of the Act, attention will be given to the extent to which there was expression of views by conservation, civic, recreation, agricultural, industrial and planning interests, as well as by Federal, State, interstate and local agencies. Particular attention will be given to the extent to which there was opportunity for participation by interests downstream or adjacent States which would be affected by the standards.

10. State standards will be reviewed in terms of their consistency and comparability with those for affected waters of downstream or adjacent States. Coordination is encouraged among States to assure such consistency.

11. The use or uses of the waters concerned, the water quality criteria to provide for such use or uses, and the plan for implementing the water quality criteria should be in conformity with any comprehensive water pollution control program developed pursuant to Section 3 of the Federal Water Pollution Control Act, as amended; should encompass any remedial program recommended by the Secretary as a result of an enforcement action taken under Section 10 of the Act; and should be revised to reflect any recommendations resulting as such programs and actions develop.

12. To meet the goals established by the Act, water quality standards must be adequate to protect and upgrade water quality in the face of population and industrial growth, urbanization, and technological change. In accordance with the provisions of the Act, it is anticipated that after the initial setting of standards, periodic review and revision will be required to take into account changing technology of waste production and waste removal and advances in knowledge of water quality requirements developed through research.

Waters to which Standards Provisions Apply

Water quality standards, under Section 10(c)(1) of the Act are to be established for, and made applicable to, interstate waters or portions thereof within the State.

1. The term "interstate waters," as defined in Section 13(e) of the Act, means all rivers, lakes, and other waters that flow across or form a part of State boundaries, including coastal waters.

2. Within this definition, waters that flow across or form a part of State boundaries are subject to the provisions of Section 10(c)(1) of the Act.

3. Waters that flow across or form a part of the international boundary between a State and a foreign country are interstate waters within the meaning of the definition provided in Section 13(e) of the Act and similarly subject to the provisions of Section 10(c) of the Act.

4. Coastal waters subject to the provisions of Section 10(c)(1) of the Act are the ocean waters along straight coasts, the ocean waters along indented coasts which are subject to the ebb and flow of the tides, and the waters of the Great Lakes.

5. As noted above, the definition of "interstate waters" is in terms of water bodies -- "rivers," "lakes" and "other waters" --- and is not limited to only those portions of these water bodies at the point at which they flow across or form a part of State boundaries. In effect, therefore, water quality standards are to be established for and made applicable to the entire stretch of the interstate waters within a State.

6. Tributaries of interstate waters, which are not in themselves interstate waters, are not subject to the requirements of subsection 10(c)(1) of the Act. However, it is important to note that the discharge of any matter into such tributaries which reaches interstate waters and reduces the quality of such interstate waters below the established water quality standards is subject to abatement under Section 10(c)(5) of the Act.

Cooperative Assistance

Within the limits of its resources, the Federal Water Pollution Control Administration will assist the States in developing their water quality criteria and plans upon request.

1. Requests for technical assistance and other information should be directed to the appropriate Regional Director of the Administration.

2. In addition, the Administration will establish national technical committees, one for each major water use defined in the Act, to review scientific findings on water quality requirements for each specific use and to advise the Secretary concerning this. Persons scientifically and technically qualified will be invited to serve. The technical committees will review and update these reports periodically to reflect new information. The findings of these committees, subject to review and approval by the Secretary, will serve as guides for approving water quality criteria and subsequent revisions thereof. These findings will be provided to the States as they become available.

3. The Administration has long-term water quality requirements research underway, and this will be accelerated. The results of this research will be made available as standards are revised, enforcement actions are taken, and programs of water quality enhancement progress.

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4. The Administration encourages and will support cooperative State-Federal activities in connection with any State water quality standards implementation and enforcement plan. Initial discussions should be with the appropriate Regional Director.

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